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METAL AND NON-METALLIC MINING · MILLING · SMELTING · REFINING · MARKETING

McGRAW-HILL PUBLISHING COMPANY, INC.

September 4, 1926

The Federal Lead Smelter

By W. N. Ellis

Proposed Ground Classification for Mining Purposes - I

By G. Townsend Harley

Problems of the Mine Operator in the Tropics

By Charles Butters

Microscopic Character of the Sullivan Ores

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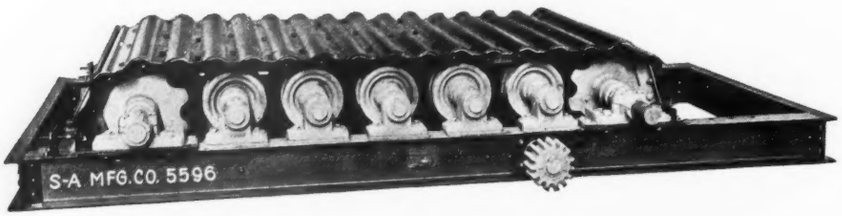

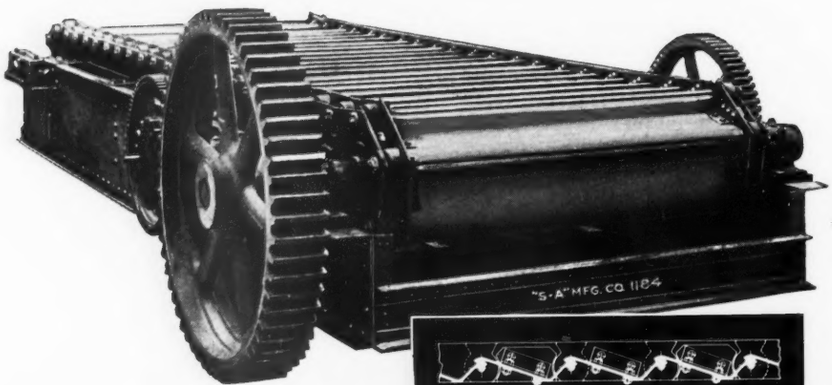

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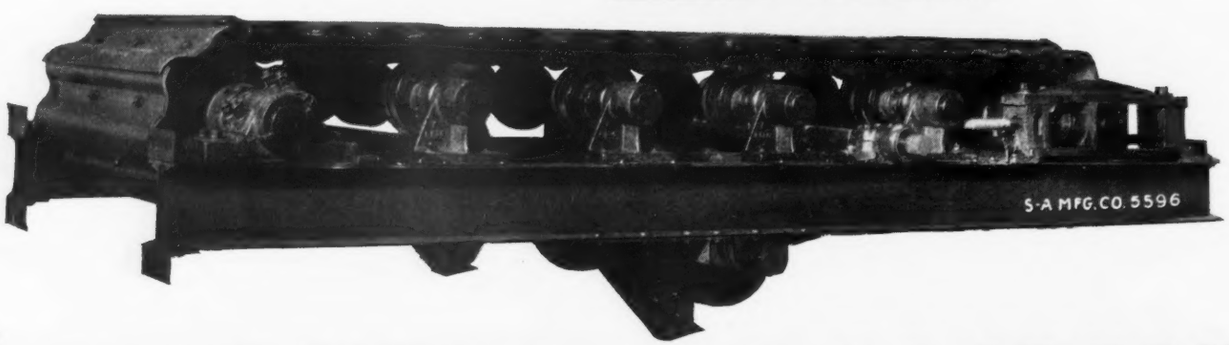

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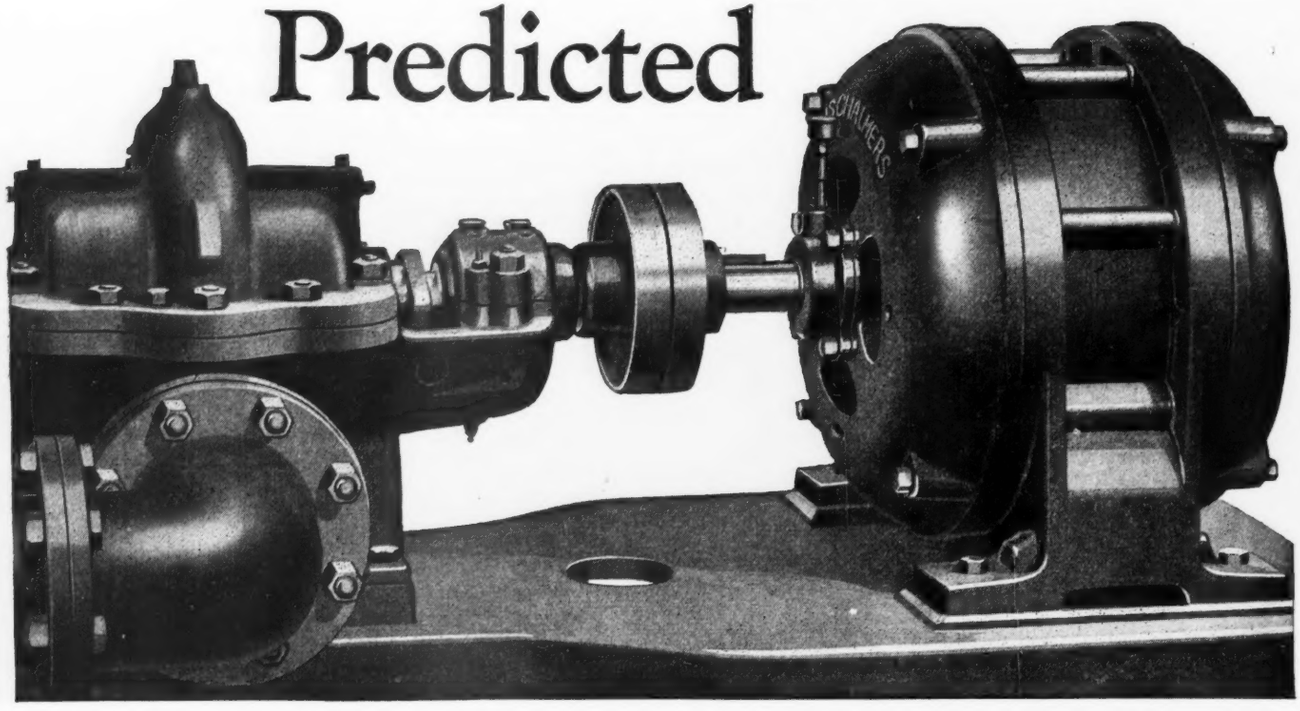

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

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The Trend of Immigration

THE EFFECT of the immigration laws governing the coming of aliens into the United States is not exactly what is commonly believed or what would naturally be expected. A recent bulletin of the National Industrial Conference Board analyzes the situation. During the last fiscal year, 1925-26, more alien Italians left the United States than the arriving numbers, so that there was a net loss to the United States of 10,630. This speaks eloquently of encouraging economic conditions in Italy under the dictatorship of Mussolini. Immigration from Great Britain during the year fell off, compared with the preceding year, and was more than 4,000 short of its quota. As in the previous year, the greatest influx came from Canada, that country sending 91,000 immigrants. It would have been pertinent to have stated how many of these were French Canadians, since the whole aspect of the immigration problem is affected by this question.

A considerable increase developed from Mexico, from which country, as from Canada, immigration is unrestricted. Altogether, 43,000 Mexicans emigrated to the United States during the year, or 10,000 more than in the year before. This is a movement which is regarded with mixed feelings by the people in the border states, like Texas, New Mexico, and Arizona, where most of the Mexican immigrants settle. For mining corporations and other large employers this movement affords a steady supply of common labor, which may be employed at moderate wages. The rank and file of the American population, however, is inclined to regret this movement and to point out that the native American character of the government, local and even regional, is in danger of being swamped by illiterate Mexicans, who have not advanced to any feeling of sympathy with the traditions and customs of the United States. We have had letters from subscribers in these states calling our attention to this situation and suggesting restrictions on such immigration. It is, of course, owing to the sense of danger of being inundated by foreign populations—a real danger—that the immigration restrictions against Asia and Europe have been established. The history of the United States is that of successive floods of European invasion, Irish, Scandinavian, German, Jewish, Italian, Greek, and so on. The earlier floods have long ago been amalgamated; but with the increase of population, amalgamation (it is amalgamation and not assimilation, as it is commonly conceived) goes more and more slowly instead of faster. The tendency is toward segregation and the perpetuation within the United States, especially in a great center of population like New York, of foreign languages, literature, and newspapers. Hence the dam that has been set up. From this point of view the question of the unrestricted immigration from Mexico is indeed one to be weighed more carefully than has been done.

The statistics show that of all nationalities 43,000 common laborers entered the United States, while 33,000 left, leaving a net gain of 10,000. Considering the common impression of the United States as a laborers' paradise, it is somewhat difficult to explain these figures. Considering again the influx of Mexican laborers to work in the mines of Arizona and New Mexico, and of French Canadians to work in the mills and lumber camps of New England, it seems doubtful whether very much of this class is being gained from Europe. But in proportion more skilled labor arrived, the net gain in this class being 47,000. Of professional people, the net gain was 9,000, showing that economic pressure is expelling these classes from their European homes more than is the case with the laboring groups.

Geological Aid in Ore Finding

TO HELP MINERS in finding ore is the desire of the U. S. Geological Survey, as shown in several ways. This determination is an appropriate one, for a government geological survey must keep in mind the practical application of its work to the immediate needs of the mining population. A recent bulletin of the Survey on the subject of "Guides to Ore in the Leadville District, Colorado," by G. F. Loughlin, is an endeavor along these lines—an endeavor to pick out from the wealth of geological data accumulated concerning Leadville those special principles which control the ultimate location of ore. In the Leadville case one of the most important of these principles is the occurrence of ores along early small reversed faults which were long antecedent to the heavy post-mineral faulting at Leadville.

Another evidence of the goodwill of the Survey is the establishing of a geologist at Denver permanently, to co-operate with the Colorado Metal Mining Association, an organization which appears commendable and one proceeding along sound lines.

These direct and relatively simple geological activities are in line with the procedure of the Canadian geological surveys, which procedure has been so successful in convincing the prospector and the miner of the practical value of geological science, and which has made these organizations so popular and influential with the people they serve. It is the type of direct contact which is accomplished to a notable degree by the various state geological surveys in the United States; and which is attained by the U. S. Bureau of Mines through its experimental stations scattered over the country, its safety work, and other activities.

This directness of attacking the miner's problems has not always been the conscious program of the U. S. Geological Survey. The ideal was once toward leisurely and comprehensive monographs; and a tendency toward a policy of holding up publication till all uncertainties

were worked out, for fear some mistake would be made which would unsettle the dignity and reputation of the geologists and the Survey. Such a reputation for infallibility was possible to maintain in the earlier days; but nowadays the spirit of scientific analysis and healthful scepticism is so widespread that such a pose cannot be held in any event; so that it is easy for the government geologist, as well as the private professional practitioner, to tell frankly what he knows and what he does not, and not suffer professionally from his frankness. Indeed, these earlier scientific ideals of never making a mistake, never acknowledging an error, and devoting a lifetime to one monograph, have long since gone by the board.

It only remains to investigate, to experiment, in order to discover what method of helpfulness will be of the most practical value. The search for fundamental principles will probably always, in the long run, yield the greatest practical results; although, in the meantime, empiric or rule-of-thumb methods which have resulted from long experience in a given district are not to be despised. But in general the guide to ore finding that is based on a sound scientific principle is the most valuable one.

There is always the question, in government activities of this sort, whether the direct contact, the approaching of the relation of consulting engineer to specific enterprises, is not encroaching a little on private business and taking the place of the professional private geologist. There need be no such overlap; properly adjusted, the work of the government representatives should introduce the private paid geological worker for such cases where intensive and sustained study is necessary—a phase of the work which the government geologists, covering a considerable area, cannot in any event find the time and means to accomplish.

As our ore deposits wane, every means must be marshalled and organized to assist in finding ore. The mechanical methods of ore finding are being diligently tested, and promise success in some regions. Geology will always, and more and more, be a necessary adjunct and precursor of mining exploration.

The Mining Meet in Denver

THE FORTHCOMING MEETING of various mining societies in Denver on Sept. 20 to 24 is of much interest. It is indeed unusual, and even unprecedented, that at a single gathering there should be represented the American Institute of Mining and Metallurgical Engineers, the American Mining Congress, the American Association of Petroleum Geologists, and the American Silver Producers' Association. Here will be grouped together the technical, the political, the scientific, and the economic representative organizations, fully equipped to attack intelligently and from all sides the main problems of the mining industries. A number of speakers have been slated who should have something worth while to say and to hear. There is no unified program, no burning issue: only an effort to talk over mining from many sides and by many men.

It should be noted, of course, that it is not the main societies that are thus meeting together. In the case of the Institute, the Mining Congress, and the Petroleum Geologists, it is the western division that is meeting. Nevertheless, although taking away something of what otherwise might be of national significance, and might constitute a precedent, the very restriction imparts a Mid-Western vitality to the idea, which, very properly, will center around Colorado. The people of Colorado are making a great effort to resuscitate and stimulate mining and are using wise and strenuous means to that effect. They are finding the various mining organizations eager to aid them in this movement. Editorial representatives of *Engineering and Mining Journal* will be present and the meeting will be duly reported in our columns.

Subway Construction a Problem in Mining

TWENTY-TWO CONTRACTORS are now at work on the first 10-mile four-track section of a proposed 57-mile addition to the present 210-mile subway system of New York City. While work on this 10-mile section was actually begun since Jan. 1 of this year, a number of the contractors have from 50 to 75 per cent of the excavation completed. Work is progressing far more rapidly than on any other previous subway construction. Why is this possible? This part of the work is strictly a mining problem, for headings are driven through sand, clay, and solid gneiss. For fifty years the mining engineer and the manufacturer have been working hand in hand developing labor-saving machinery for use in metal mines. A great advance was made over hand drills when the reciprocating rock drill weighing 350 lb. with a drilling capacity of 35 to 40 ft. per shift was invented. This cumbersome and heavy "man-killer" has been replaced by a lighter rock drill weighing from 50 to 100 lb. and capable of drilling more than 100 ft. per day in hard rock.

The handling of rock in mines has developed from hand shoveling and mule haulage to mechanical loaders, steam and electric shovels, in conjunction with steam, air, and electric haulage systems. On the subway construction the horse cart and the dump wagon of 1900 have been replaced by large motor trucks which are mechanically loaded at the working face below the street level.

Explosives so largely employed in this work have been developed by long usage and varied experience in our metal mines. In early underground mining natural ventilation was depended upon to remove the noxious fumes. Today mechanical ventilation renders the working face safe within a few minutes after a round of shots is fired.

The problem of excavation and removal of earth and rock is complicated by reason of innumerable water and gas mains, electric and telephone cables, and even trunk sewer systems, all of which must be held intact during construction work. At the same time it is necessary to maintain a steady flow of heavy street traffic. The subway often, and in fact usually, is below the foundation of large buildings, and here the experience of miner and mining engineer is drawn upon to devise ways and means to support the heavy overburden without settlement to the detriment of the structures above. Although most of the machinery and equipment was developed and perfected in the mines, this same machinery has found a place other than in mining rock from which precious metals and structural

materials are obtained—where it is used to add to human comforts. It is preparing the way to alleviate the transportation conditions that exist in all metropolitan areas.

From another point of view subways would be impossible without mining. The iron mines of Minnesota supply the millions of tons of structural and rail steel so necessary in this work. The copper mines of Michigan and the Rocky Mountain States supply the copper for the electrical operation, while the lead mines of Missouri and the Far West provide a corrosion-proof covering for the copper cables. Truly mining is a basic industry upon which civilization is built.

Advertising Silver and Gold

WHEN the American Silver Producers' Association meets at Denver this month, some attention may well be given to a publicity campaign for increasing the popularity of articles manufactured from silver and gold. If India is to take much less silver in the next few years than has been her custom, other avenues of consumption must be opened up. There was some talk of this matter a year or so ago, at previous meetings, but apparently nothing definite has been done; at least the general public has not been urged to consider the advantages of buying sterling or silver-plated articles. In this respect, the average American is perhaps behind the average Hindu; where the East Indian invests his wealth in silver and gold articles of intrinsic value, the American is wont to buy things whose scrap value is little or nothing.

Silver is, of course, the standard material for tableware, but this is possibly the only home use of the metal that is not without serious competition from other metals. Even for tableware some effort may be necessary to maintain its position. Something may well be done, also, to restore the fading popularity of gold, especially in jewelry. Platinum engagement and wedding rings are now *à la mode*, though they are much less beautiful than gold, and the white metal does not begin to be as good a background for diamonds. The chief virtue of platinum for this purpose seems to be that it is more expensive, and he who buys engagement and wedding rings does not like to have it thought that expense is considered.

Getting Acquainted with Copper

THE PERSONAL POSSESSION of copper by the inhabitants of the United States has greatly increased in the last few years, though those who possess the metal may not realize the fact. The largest consumption of copper of course still goes into motors, generators, switchboards, telephone, telegraph, light and power lines, pipe, machinery and fittings, but the more personal uses account for an increasingly large percentage of the total. Automobiles, alone, take over 100,000 tons of copper a year in the United States, so the home owner, who in most instances also possesses a car, must have many pounds of copper in his garage. Copper screens on his windows are becoming more common all the time, for with the present high cost of labor he does not wish to have the screens taken apart and renewed every few years. He is also getting used to clean hot water for his bath—provided by a copper boiler in the kitchen and brass pipes in the walls—which incidentally insure further a comparative freedom from the expensive services of a plumber. His radio set requires an appreciable amount of copper, and he has probably bought a pound or two of copper, as such, for his antenna. Electric refrigerating machines in the home, heretofore a curiosity, are being introduced rapidly; it is estimated that 15,000 tons of copper will be required in their construction during the current year. Electric washing machines, with their sheet-copper bodies, are now a common sight in the home laundry, and the advantages of dish washers are gradually being realized. Copper is a beautiful metal as well as an enduring one, and the home owner may well take pride in its possession. Its chief disadvantage in the home is perhaps its susceptibility to tarnish, tarnish that requires considerable elbow grease to remove. But once nicely polished, the beauty of copper may be preserved for some time by a coating of lacquer, such as clear Duco, or one of the other nitrocellulose compounds that have recently appeared on the market.

Without doubt, the comparative low level of copper prices has had a beneficent effect in widening the uses of the metal. Even manufactured articles of copper and brass are obtainable by the ultimate consumer at much more reasonable levels than prevailed some years ago.

Service and Its Abuse

A MINE-CAR MANUFACTURER recently complained of a practice that he said was all too prevalent. A certain mining company, for example, needs cars of a special design perhaps to meet peculiar operating conditions. It naturally makes known its wants to several competitive manufacturers. Whereupon these put their engineers to work, and ultimately each of them, after spending considerable time and money, submits to the prospective customer his solution of the problem, expressed in detailed drawings accompanied by an estimate. Does anyone of the competitors land the order? At times. But all too frequently, it is alleged, what happens is this: the mining company rejects all bids, and having the advice and drawings of several manufacturers, all entirely gratis, proceeds to make its own cars. Or instead of doing this, the company, from the half dozen or so sets of drawings furnished by the competitors, prepares a composite design embodying the best ideas submitted, and on it seeks bids, perhaps from manufacturers who have hitherto contributed nothing.

Such practice in placing orders for new equipment is without doubt questionable. It is hardly fair. It is made easy by the highly competitive conditions that exist in certain lines. It is the result of the free giving of service that is so marked a characteristic of the manufacturing world today. What is the answer—the remedy? There seems to be none—save to say that the golden rule is not yet an obsolete "gag" to all, and that its observance by companies is as desirable as by individuals. The doctrine "live and let live" may be anathema among competitors, but the mine operator is not a competitor of the manufacturer. Instead, he needs the manufacturer, perhaps more than he realizes and almost as much as the manufacturer needs him.

The Federal Lead Smelter

This A. S. & R. Unit, Now Enlarged and Modernized, Can Turn Out More Lead Than Any Other Smelter in the World—High-grade Missouri Concentrates Are the Raw Material

By W. N. Ellis
Assistant Superintendent, Federal Plant, American Smelting & Refining Co., Alton, Ill.

THE FEDERAL PLANT of the American Smelting & Refining Co., having been doubled in capacity in the last three years, now has the largest productive capacity of any lead smelter in the world, though in actual tonnage of ore smelted it does not compare with some of the larger Western or Mexican plants. It is situated just east of Alton, Ill., about 20 miles north of St. Louis, and is conveniently reached from both the southeastern Missouri lead district and the southwestern Missouri, or Tri-state, lead-zinc district, from which regions most of the ores smelted are derived. The concentrates received are high-grade, the coarser material averaging from 70 to 80 per cent lead and the flotation concentrate from 50 to 60 per cent. The zinc content varies from 2 to 6 per cent, the slime being the higher in this impurity. The one outstanding quality of all the Missouri ores is the low silver content, which makes unnecessary the more complicated refining methods ordinarily required for base bullion. Two distinct methods are followed in smelting, one employing improved Scotch hearths for reduction, and the other, blast furnaces, preceded by a sintering operation.

Handling of Ore on Arrival

The concentrates are received in either box or dump cars. These are weighed immediately on arrival on a new 125-ton track scale of the latest Fairbanks Morse type, and the material is then sampled for assay and to determine the moisture content. All high-grade and coarse concentrates are then delivered by trestle to concrete and steel bins, where the cars are unloaded either by shoveling or dumping. These bins have a capacity of about 900 tons each. After a bin is filled, it is allowed to stand for several days to permit the concentrates to "sweat," a procedure that aids materially in the operation of the hearths. All flotation and low-grade concentrates are unloaded into steel hopper bins for roasting and subsequent smelting in blast furnaces.

Ore for the Scotch hearths is loaded by hand into three-ton cars, which are delivered to the hearth building by electric locomotives. A layer of baghouse dust is first spread over the bottom of the car, and then it is filled with ore. The cars are constructed so that one side will drop down and make a level surface from which to shovel the charge to the furnace. Each furnace man thoroughly mixes the charge before adding it to the hearth.

At present thirty hearths are installed. They are the Newnam type of mechanical hearth developed at the smelter of the St. Louis Smelting & Refining Co., a few miles away, and are distinguished from the old Scotch type of hearth by the mechanical rabbling system, by which a great deal of irksome labor is eliminated. The basins for these hearths are 8 ft. long, 19½ in. wide, and 10 in. deep, though a 10-ft. hearth is now being installed as an experiment to see if the tonnage per man can be improved thereby. Both cast-iron and steel jackets are used, the last-named being capable of being welded, whereas the cast-iron ones are valueless after they have burned out. Each hearth has an individual flue leading to the main flue and also a connection to the outer air. Constant cleaning of the flues is carried on, owing to the fact that the dust burns and cakes on the flue, thereby cutting off radiation of heat from the gases. There are twelve tuyères on each furnace, which deliver approximately 1,000 cu.ft. of free air per minute to each hearth at 8-oz. pressure. Various blast pressures have been tried, but it has been found that 7 to 8 oz. gives the best results. The finer the charge, however, the more pressure is required to penetrate it.

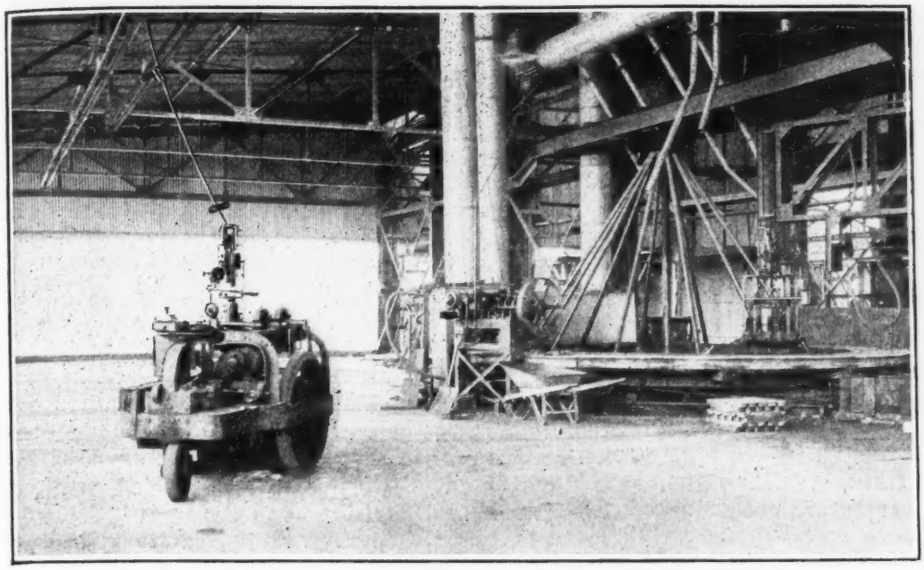
Part of Dust Added to Hearth Charge

The charge to the hearths consists approximately of 70 per cent high-grade concentrate and 30 per cent burned baghouse or trail dust. The addition of coke braise as fuel is left to the furnace-man, but averages about 8 per cent of the weight of the metal-containing charge. Lead from the basins is tapped into cast-iron molds attached to a revolving table at the end of the hearth, there being ten molds to each table. Each pig weighs approximately 100 lb. Two men are required to operate each furnace per eight-hour shift for maximum efficiency, though at times one man works alone. All handling of materials in this department is done with electric locomotives.

About 60 per cent of the lead charged to the hearths is recovered in the bullion, which is exceptionally pure and makes an ideal product for the refinery. The remainder goes into the gray slag, which is skimmed off the charge during the smelting operation, and into the fume. The gray slag is delivered to the blast-furnace bins for further treatment. It averages about 48 per cent lead, 7 per cent "insoluble," 16 ferrous oxide, 7 calcium oxide, 3.5 magnesium oxide, 11 zinc, and 2½ to 4 per cent of sulphur. Part of the fume is returned to the hearths and the rest goes to the roasters for subsequent blast-furnace smelting.

Both Sintering Machines and H. & H. Pots Used

The lower-grade concentrates are smelted in the blast furnaces after roasting in two Dwight & Lloyd sintering machines and fourteen H. & H. pots. The D. & L. charge is made up of flotation and fine table concentrates, flue dust, iron scale, and matte. It is assembled by drawing each material from 50-ton cone-shaped hoppers equipped with adjustable gates. The short conveyors under these hoppers deliver to central conveyors, which, in turn, deliver to an inclined conveyor carrying the mixture to a revolving trommel, where a thorough mixing and moisture adjustment is made. The trommels discharge to individual machine hoppers with



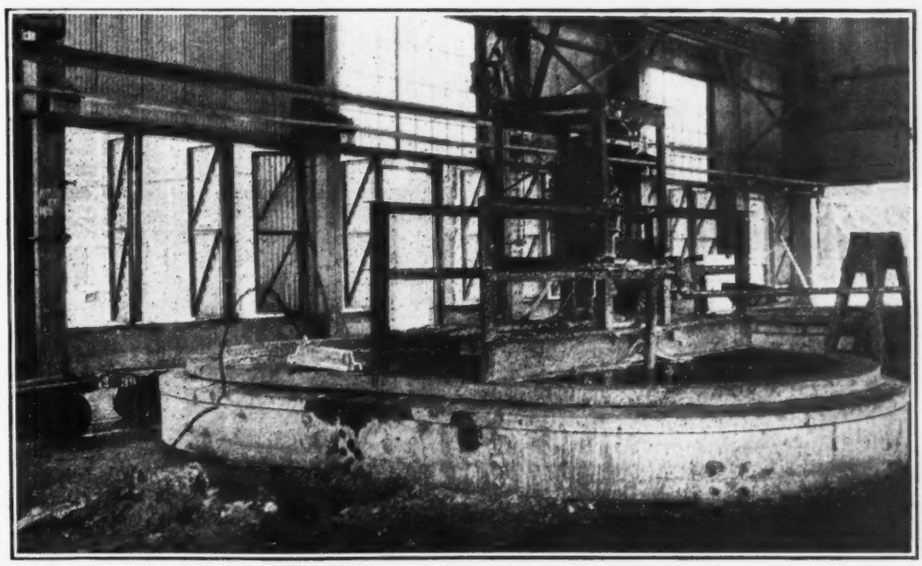
One of the improved casting wheels. Each pig is stamped and removed from its mold mechanically, a pile of pigs then being carried to the scales and into a box car by the electrically operated buggy shown at the left

conical bottoms equipped with feed belts and adjustable gates for regulating the feed to the sintering machines.

The Dwight-Lloyd machines are of the standard type, 42 x 264 in., with certain changes adapted to this plant. Cast-iron wind boxes and flue connections are used and have given very satisfactory results. At present, a system is being installed that will provide for the return of fine material to the charge, such fine material including windbox cleanings, grate siftings, and fine roasted material from the pots. Fuel oil is used to ignite the charge, it being burned in either cast iron or fireclay muffles. A 4-in. bed on the grates has been found to give the best results, on account of the physical characteristics of the charge. The speed of the machines varies from 18 to 30 in. a minute, the average being about 22 in. Cast-steel grates are used on the pallets, the improved Trail or Stewart grate having been found the most satisfactory form in view of the comparative ease of keeping it clean.

No attempt is made to make a hard sinter out of this "pre-roast," but rather the charge is given a flash roast to secure a nodulizing effect, which has been found to give the best final roast in the H. & H. pots. The sulphur content is reduced from 14 to 9 per cent. The sintering machine product, about 200 tons per machine per day, is delivered to stock pots placed on a turntable operated by an overhead crane. As the roast leaves the machines, it is thoroughly moistened, which also aids in breaking it down. Roast from the stock pots on the turntable is transferred to other stock pots, thus securing a thorough mixing of the charge and a more uniform moisture content, which is essential for good pot work.

Final roasting is carried on in fourteen H. & H. pots of standard dimensions. Owing to the amount of metallic lead produced with a high lead charge, the old style tuyère connection and charge pot was not found practicable here. Accordingly, a type of pot was developed which has proved very satisfactory where high lead charges are used, and, in fact, under all conditions. Its features include a heavy cast-iron ring attached to the pot sides, the sides of the pot and the ring holding the grate in place. The pits are of concrete, approximately 4 ft. deep, mounted with a cast-iron U-ring. This ring is packed with mineral wool, thus forming a tight seal and preventing leaks when the charge is placed thereon. All tuyère connections are done away with and a more even air distribution to the charge is insured. Cast-iron pots and hoods are used, and the grates are made up of segments of castings perforated with round holes. Two



One of the 110-ton cast steel kettles, on top of which is the electrical pumping equipment. Note the pyrometer inserted over the side to make certain of having the proper casting temperature

electric cranes serve this department for charging, dumping pots, and miscellaneous work.

The charge for the H. & H. pots is made up entirely of the D. & L. product, three charges per twenty-four hours being the usual practice. Air is furnished to the pots by a fan capable of delivering 16,000 cu.ft. of free air per minute at a blast pressure of 10 oz. The pressure at the pots is maintained at 6 oz., which gives a good roast. The pot product is a hard sinter averaging about 50 per cent lead, 18 ferrous oxide, 7 "insoluble," 5 calcium oxide, and 3 per cent sulphur. This roast is dumped on a stock floor, transferred to a crusher by an electric crane and manual labor, and crushed to a maximum size of 6 in. After crushing, the roast is transferred to the blast-furnace stock bins.

Blast-Furnace Smelting

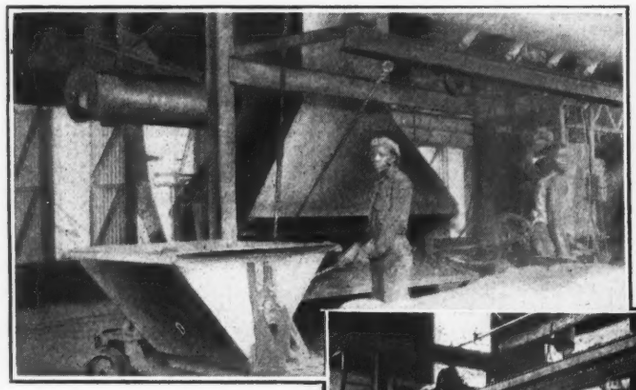
At present there are two blast furnaces 144 x 42 in., and one 176 x 42 in. In the near future one of the small furnaces will be made the same size as the larger one. Steel water jackets are used one tier high, the shaft being brick from the top of the jacket to the charge floor. Besides the regular outlet from the top of the charge to the furnace top, side flues are also built in to aid in the elimination of the gases, an innovation that gives very satisfactory results. The cover on the furnace works automatically; when the charge is dumped, the weight carries the gates down and they are released when the charge is in the furnace. Charging is done by hand buggies on a contract basis. The charge consists of gray slag, pot roast, dross, and suitable fluxes. The charge is delivered to the blast furnaces by a transfer car running up an incline.

Blast is furnished to each furnace by individual blowers. An average pressure of 22 to 28 oz. is used for the greater part of the time. Because of the heavy lead fall, a continual overflow is used. The lead discharges into 2-ton cast-iron pots, arranged to be dumped with an air lift at the refinery. Two slag pots are used at the furnace, the first receiving the matte and some slag and the second the slag. The slag goes over the dump, as shown in the illustration on the cover, and the matte to the yard, where it is broken up, the slag being returned to the furnace and the matte sent to the roasters. Some matte is shipped out when the copper is sufficiently high. The slag produced averages about as follows: 28 per cent silica, 35 ferrous oxide, 13 calcium oxide, 6 magnesium oxide, 5 aluminum oxide, and 10 per cent zinc. It is probable that no other plant in the country has the high total of magnesium, aluminum, and zinc oxides that obtains here. The slag fall is approximately 33 per cent, and the matte fall, 5 to 6 per cent.

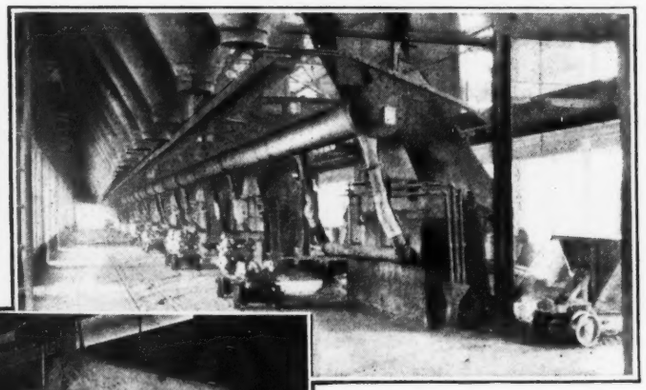
Refining Is a Simple Operation

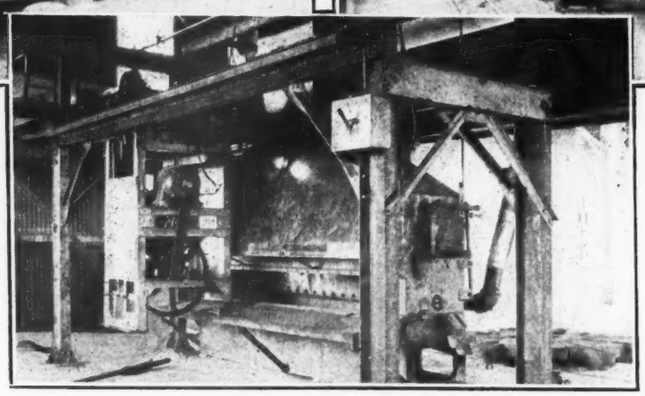
The refinery is a new steel and concrete building, designed so that a minimum of labor is required for handling the large output. There are six 110-ton, cast-steel kettles, oval in shape. Four kettles are used for the drossing and casting, a fifth one being used for blast-furnace lead, and the sixth for reserve. All incoming lead is melted very slowly, carefully drossed, poled by means of air attached to each kettle, and drossed again. The kettles are then cooled, when a final dross rises to the surface, which is skimmed just before casting. Careful attention is given to the temperature for casting, pyrometer connections being provided at each kettle. Blast-furnace lead is given an extra drossing before being cast in 1½-ton blocks. Coal firing is now used. Oil was tried, but much better heat control is maintained with coal, and fuel oil is much more expensive. All transferring of lead is done with vertical motor-driven pumps.

The casting is done in the daytime, and only during six days a week. Lead is pumped directly to the casting wheel, regulation being by means of a valve and adjustment of the pump speed. Quick connections are used to avoid line freeze-ups. The final product shipped averages 99.92 per cent lead and 0.065 per cent copper. A circular casting wheel equipped with mechanical mover, stamper, and pig-puller is used, the equipment being essentially the same as that developed by W. E. Newnam at the Collinsville smelter. Pigs are taken from the mold five at a time and stacked in piles of

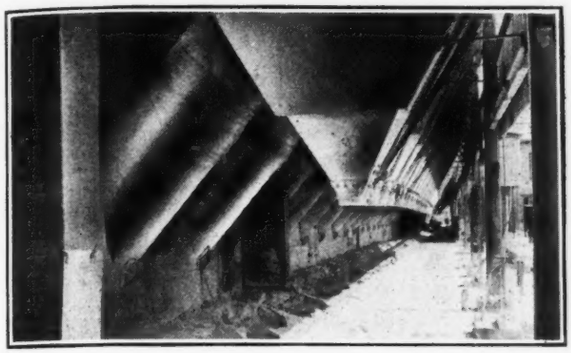


Above is shown one of the Scotch hearths with its operating crew of two colored men. The car in the left foreground is provided to receive the gray slag which is skimmed, in a semi-solid condition, off the surface of the charge.

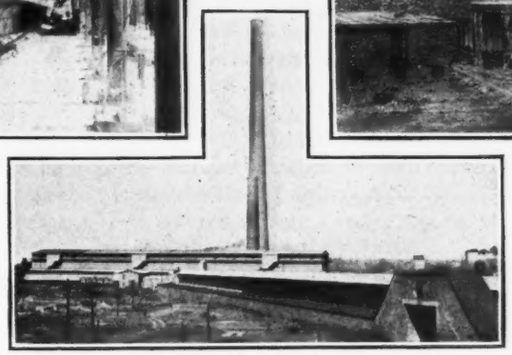


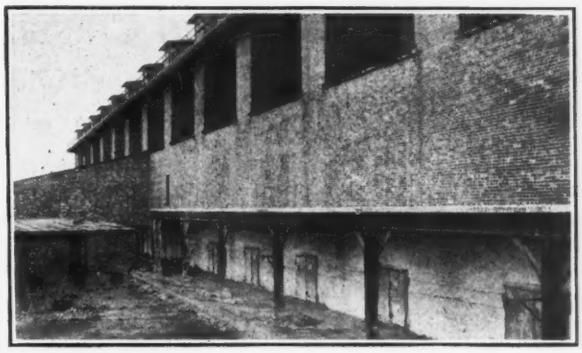


Above is a line of hearths, showing the rear sides, and the cars on which the pig lead is removed. To the left is one of the new 10-ft. hearths just constructed. Note the suspended mechanical stirring apparatus, and on the right, the casting molds.



Intake side of the brick baghouse, showing floor on to which the burned dust is removed. To the right is a general view of the flue system, with the 450-ft. brick stack





Above is a view of the back side of the baghouse, at the center of which the gases are led off to the stack

thirty-five or forty. From the casting wheel the lead is transferred by a mechanical buggy to one of two sets of scales, and thence to the railroad cars. The labor required for the casting table is one pourer, one trimmer, and one pig-puller, with which crew the capacity of each casting wheel is as high as 300 tons per eight-hour shift. All casting is done on the contract basis.

Fume Disposal an Important Problem

Where Scotch hearths are operated, the fume problem is of vital importance. The equipment at Federal is modern and satisfactory. There are three long flues leading to the baghouse—one brick flue from the roasters, and two steel flues leading from the two hearth buildings, the gases being exhausted from the flues to the baghouse with three large fans. The baghouse proper consists of sixteen rooms, each equipped with 268 bags, 26 ft. long and 18 in. in diameter. The bags used are the standard woolen bags, other kinds having been used but found not so satisfactory. Shaking of bags is done mechanically, five rooms being attended to at a time. The rooms are fired twice a week, thus avoiding intense heat when burning. The burnt dust is returned to the hearths, being loaded by hand into tank cars, on the contract system, and returned to the stock bins with electric locomotives. The baghouse fume averages about 65 to 68 per cent lead and from 3 to 5 per cent of cadmium. From the baghouse the gases are delivered to a 450-ft. circular stack, which is shown above, and which is equipped with a stack heater for use when necessary.

An addition of five new rooms containing 30-ft. bags instead of 26-ft. is now being made to the present baghouse, and another fan is also being installed to take care of the gases.

Physical Comforts and Medical Attention Provided

Approximately 450 men are employed at Federal, the greater part of them being colored. Contracting is done wherever possible, as experience has shown that with this class of labor more satisfactory results are thus obtained. Wash rooms, showers, and lockers are provided, along with soap and towels, and suits are furnished to all baghouse men once a week. A doctor is in the plant certain hours each day, for the care of all men who are working there.

Copper Lightning Rods

The recent destruction wrought by a bolt of lightning in the naval ammunition depot at Lake Denmark, N. J., would have been prevented, according to Professor Pupin, of Columbia University, if the depot had been adequately protected by copper, scientifically applied. It would have formed an absolute means of protection against fire and other dangers from lightning. Professor Pupin's statement was as follows:

"If you have a house and want it protected from the dangers arising from lightning, put on a copper roof, protect the chimneys with copper sheeting and then connect the roof at a great many points by copper rods or heavy copper wire with the ground. The copper rods or wire must go deep into the ground, into wet soil.

"Then you copper the sides of the house with copper sheeting or other metal and this must also be connected with the wet ground. If this is done, no lightning can get into the building and everything and everybody in it will be perfectly safe from that source of danger. The moral is, all ammunition depots and all structures where explosives are kept should be constructed in that way."

Such protection as described above would be somewhat expensive for the average house to undertake, says *The Metal Industry*, but certainly an ammunition depot should spare nothing. Professor Pupin added that lightning rods in themselves were also good, but there must be enough of them where the danger is great and they must be well connected with wet ground. He recommended gilding at the top to prevent rust, but copper rods might not find this necessary.

Granulation of Slags and Metals

B. Bogitch (*Compt. rend.*, abstracted in *British Chemical Abstracts*) states that in the granulation of slags and metals by quenching, dangerous explosions may occur if too much molten metal is entrained in the molten slag. A jet of compressed air introduced below the water surface serves to retard and break up the molten stream, and to prevent the formation of a solid sheet over the surface of the vessel. Experiments with an iron-magnesium silicate slag and a molten metal, using air compressed to 1 kg., showed that quenching may safely be carried out in smaller vessels, and from a less height than is usual. The hot water produced may also be utilized.

Proposed Ground Classification for Mining Purposes—I

Rock Characteristics Determine Stoping Methods and Form Basis for Bonus or Contract System of Wages

By G. Townsend Harley
Morenci, Ariz.

THE outstanding and fundamental factor that most influences all underground operations is the physical nature of the ground with which the operator has to deal. These ground characteristics very largely determine the stope methods that may be used to advantage and the size and type of development headings that may be economically driven and maintained. They will influence the size and kind of equipment and supplies used, from the drilling machines at the working face, the type and weight of drill steel, the quantity and grade of explosives, to the particular size and type of shovels and scrapers that can be used to best advantage, the type and weight of cars and skips, the kind of chute and pocket linings that will give the most economical service, and the amount of repair and replacement work necessary to keep the mine open and the equipment in good operating condition. It is, in fact, the character of the ground that is most clearly reflected in the over-all efficiency of the plant, expressed in the usual terms of tons mined per man and in the cost of mining per ton.

Operations in mining have usually been initiated and conducted more or less on the "trial-and-error" method, and there are many who hold that the conditions existing underground make this method of approach inherently necessary; that there is little or no chance of reducing the percentage of errors made, by any prediction through a scientific rock classification, as to how ground will react to any given operations; and that the only feasible and practical way to secure final correct results is by hard and oft-times costly experience with the block of ground under consideration. On the other hand, there are a few men in the industry, notably those who have been pioneers in time-study work or in the standardization of various operations, who feel that if all the practices of the past and the results thereof, both good and bad, could be brought together and studied under the strong light of a scientific ground classification generally acceptable to all, the mass of information so reviewed would in a short time enable them to set definite and practical limits upon the applicability of each operation or method, and would indicate a range of practice for each class of rock, whether it be a standard drill round, a correct powder allowance, the maximum safe open area allowable, or the most efficient stoping method, beyond which it would be inadvisable to extend except for purely experimental reasons.

Older Classification Methods

Probably the first attempt at ground classification, and certainly the one most generally used today, is the local usage of such terms as hard, medium, soft, easy-breaking, and so on. Each mine operator divides his ground into some or all of those classes in explaining variations in his cost sheet, or, when the usage is extended, to compare the costs or the methods in the mines of any one district where each operator is thoroughly familiar with the ground in every other mine. Beyond this point it has no general application. At the various mining camps, ground is classed as soft, for example, that would range in any generally applicable classification from very soft to medium hard. On the other hand, ground classed as very hard in one locality might be the softest ground with which one has to deal in another district, and would there probably be called soft or medium. What would be good ground or easy-drilling ground with a heavy, mounted drifting machine would be hard ground when drilled with an unmounted type of drill elsewhere. These terms as used, therefore, have no meaning in the larger sense; they cover only in a general way the range of ground in any one district, and take no cognizance of the place that the local ground may have in a general scheme of classification. As a result, a comparison of methods, costs, and efficiencies in various camps is at best a guess, limited to those who are familiar with the camps compared, and almost impossible to one who has not visited each of the places and made a close study of the ground. The same thing holds true for any comparisons that might be made, of explosives consumption, drilling speeds of machines, crushing and grinding data, and so forth.

Ground Classified Under Rock Names

Another ground classification scheme, which however has had no general use, is that based on the rock name, such as granite, diorite, basalt, sandstone, limestone, and the like. The faults of such a scheme should be obvious. The character of each rock type, if of the same degree of freshness, and always of the same mineralogical composition and texture, might be roughly comparable, although, even then, it is doubtful if it would be close enough for accurate work. But when we take into consideration the comparatively wide range in mineral composition and the varying textural structures that enter into any one rock type, and the different degrees of weathering, alteration and decay that are encountered in different regions, or even at different depths in the same district, we can see how impossible it is to rely on the rock name for any of the qualities that are of importance in practical mining operations.

Bonus System of Wages Based on Ground Classification

Coincident with the advance in efficient methods of underground mining in recent years, and the serious work of standardization that has been carried on by a number of mining companies, have arisen other and more accurate methods of ground classification. Indeed, by its very nature, the work of standardization has been largely dependent upon some prior system of accurate classification before much of any advance could be made. This is most strikingly shown in connection with the introduction of bonus systems of wage payment, which are becoming increasingly popular over the older contract systems, where it is apparent that if the company is to be a beneficiary in any improve-

ments in working conditions, new equipment, and advanced methods, and if it is hoped at the same time to satisfy the laborer and pay him a fair return for the work he expends under these changed conditions, it is essential to know exactly under what conditions each man has had to work, and how changes in these

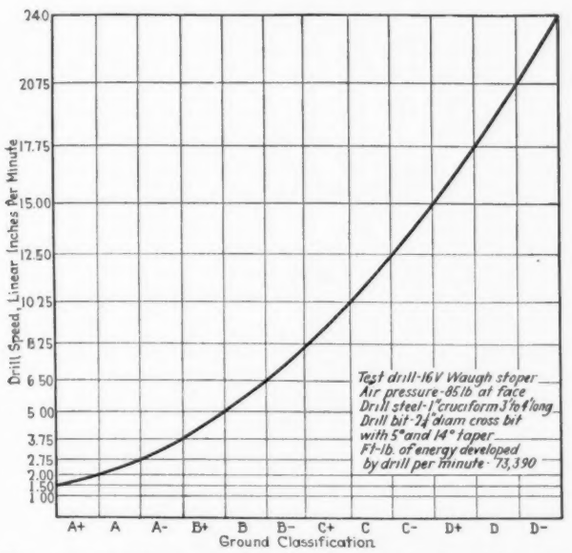


Fig. 1—Drilling speeds and ground classification

Class	A+	A	A-	B+	B	B-	C+	C	C-	D+	D	D-
Drill speed linear inch	1.50	2.00	2.75	3.75	5.00	6.50	8.25	10.75	12.50	15.00	17.75	20.75	24.00
Drill speed cubic inches	5.97	7.96	10.95	14.93	19.90	25.87	32.84	40.80	49.75	59.70	70.65	82.59	95.60
Ft-lb. energy per cubic inch drilled	12,300	9,225	6,700	4,920	3,690	2,835	2,235	1,798	1,475	1,230	1,038	889	768
Increment	3,075	2525	1,780	1230	855	600	437	323	245	192	149	121	

Fig. 1a—Drilling speeds and energy consumed

conditions will affect his productive capacity in the future and the bonus standards or contract rates that may be set for him.

Basis of Classification at One Deep Mine

One such classification scheme to take on a semblance of real accuracy was that developed at a northern deep-vein mine. Although, unfortunately, the old terms, "extra hard," "hard," "sharp," "medium," and "soft," were still used, these terms were based on carefully obtained data, and hence were definitely restricted in meaning at this one property. The data upon which these terms were based, in drifts, raises, and winzes, were the drilling speeds of the machines, time studies of the cycles of operations in the working places, the spacing of drill holes necessary for the economic round, the economic depth of drill holes, and the amount and distribution of explosives in each hole to break the rounds to their full depth with a minimum of wasted energy. In the stopes two new terms were added, "frozen walls" and "free walls," and variations were made in the spacing of holes, powder allowances, and other factors, to correspond. Schedules and instruction cards were drawn up for each typical case, so that any man going into a working place, and carrying with him the correct card for the character of the ground and the conditions in that place, could learn from his card at once how many holes to drill for each round, their depth, location, angle, and proper spacing; what powder charge to put into each hole, the order of firing, and other details, and finally, knowing the conditions in his working place and the daily results of his work, he could estimate from the data given on the card how much bonus he was earning for the work he was doing.

The only other scheme of underground classification to be mentioned here, and the one which is probably the most generally applicable of all of those so far advocated, is that which has been developed at a southwestern mine. The general applicability of this scheme is due not so much to the method of determining the rock characteristics as to the new terms that have been used and the definite way in which these terms have been restricted in meaning. All ground is classified, from the hardest to the softest, as A+, A, and A— and so on to D+ D, D—. For each class of ground, a breaking quality based on the occurrence of slips, and numbered 1 to 5 (1 being the toughest and 5 the easiest breaking) was designated, and for each class and breaking quality a standard drill round and powder allowance was worked out.

The history of the development of the scheme is as follows: At the start of the work, the rock was roughly classified into hard, medium, and soft, corresponding to A, B, and C, by means of a pointed steel and a hammer, and also with a geologic pick. Then a new Waugh 16 V stoper was used in a great many places to determine the drilling speed limits of the three classes. With the stoper a pressure gage was used to make sure that there was no serious variation from the average air pressure of 85 lb. at the face, a standard size and shape of drill bit was used, and the drilling speeds were always taken at about the same distance in from the face. A small classifying drill was then obtained, which was calibrated against the 16 V stoper, and was used for about six months in all rocks, so that those classifying could become thoroughly familiar with the different rock hardnesses. All during this work with the drills, each face was also tested with the geologic pick, so that the "feel" of the ground could be learned. When the drilling characteristics of the ground had been thoroughly learned, all further classification was done by these experienced men by means of the geologic pick only, in a very satisfactory manner, as one who is at all in touch with the drilling work can detect differences very easily as he goes from place to place examining the ground, particularly if he checks himself by taking drilling speeds occasionally on the machine working in the face. This is done by counting the turns of the crank (two turns = 1 inch) in the case of drifting machines, in a specified time. Fig. 1 shows the drilling speeds obtained in the various classes of ground, as explained.

Breaking Quality Closely Follows Hardness Classification

Subsequently it was found that the breaking quality closely followed the hardness classification, and for the sake of simplicity, a standard powder allowance was specified for each class (A+, A, A—, etc.), which is generally used except in a few cases where the variation from the average is extreme. There is also a tendency to reduce the number of standard rounds, using the same round for two or more classes of ground, wherever possible. This is an apt illustration of the logical method of gathering and applying data to practical purpose—first, the accumulation of detailed information

on the existing conditions; second, the working out in great detail of standard methods for each condition; and, third, the logical simplification and combination of these detailed methods into a schedule combining the elements of economy and efficiency.

A paper which is of great value in connection with any work on rock classification is that presented by Luther W. Lennox before the Colorado meeting of the A.I.M.E. in September, 1918, entitled "Grinding Resistances of Various Ores." For this purpose, Lennox obtained various samples from the United States and Alaska, which were ground under standard conditions to determine their resistance to the energy applied by the test grinding machine.

Quoting Lennox: "The experimental grinder was a small iron tube mill 8x12½ in. in which was placed a definite number (74) and weight (3,450 gm.) of ¾-in. steel balls, 1 lb. water and 1 lb. ore. To obtain uniform condition, each ore was first crushed and screened, and from the sized products a 'standard feed' was artificially prepared, the same standard being adopted for all tests in that particular series. The prepared feed was placed in the little mill, and this was allowed to revolve at 84 r.p.m. for a definite time; the sample was then dried and screened. The whole operation was then repeated for other periods of time."

Lennox used the method of Rittinger for computing his results. This is based on the law that the work done in crushing is proportional to the surface exposed by the operation, or to the reciprocal of the diameter. By charting the screen analysis of the "standard feed" and the product obtained by grinding, using the mesh (reciprocal of diameter) and the cumulative per cent of oversize as co-ordinates, he obtained an area between the feed and product curves which is proportional to the "apparent work done." The apparent work done is inversely proportional to the resistance of the ore to grinding. That is, the smaller the amount of reduction made on the sample, for a given power input, or the closer the feed and product lines are together on the crushing-surface diagram, the greater is the resistance of the sample tested.

From the above, then, it is apparent that a system of rock classification is of interest to mill men in connection with their crushing and grinding problems, as well as to the mine operator who desires to secure a correct base upon which to design drill rounds, set powder allowances, develop correct mining methods, and apply equitable standards in special wage-payment schemes. It would also seem obvious that a general scheme can be worked out, and all data compiled upon it as a base, by means of which, when one speaks of a certain class of rock, whether one may choose to call it very hard, or whether one designates it as "A" ground, or ground with a grinding resistance of 1.0, everyone in the industry may be able to call to mind a picture of the rock so designated and of the methods and practices that are being successfully applied to that class of rock throughout the country.

Proposed Classification Based on Actual Experience

The scheme of classification as here proposed was conceived while engaged in standardizing methods at one of the southwestern mines. Intensive experimental work has been done with it, within a comparatively restricted range of ground, with a very slight amount of work in some extremely hard rock, and in all cases the mining results successfully obtained have been noteworthy in that they closely followed predictions made based on the classification.

For the purpose of the work, only the physical characteristics of rocks need to be considered, and these fall naturally under the following headings:

1. The rock weight (specific gravity, volume per ton in place, volume per ton broken).
2. The degree of hardness.
3. The degree of toughness or friability of the rock.
4. The occurrence of slips in the rock.

Each variation encountered in the rocks opened up in mining will be accounted for according to each of these headings.

1. *The Rock Weight*—The weight of the rock will be determined by a few specific gravity tests made upon representative samples of the rock from different parts of the mine. Also, the weight of ore removed from the mine will be examined in relation to the cubic content of the cars and bins in which it is transferred and stored to obtain its volume when broken, and with the volume of the opening from which it was removed to obtain its volume in the solid state. The weight of the rock to be handled finds general use in production calculations, in operating records of haulage and hoisting, in reference to size and design of equipment, in calculations involving swell in shrinkage and caving stopes, and in surface subsidence problems.

2. *The Degree of Hardness*—The hardness of a rock depends primarily upon the hardness of its constituent minerals and the proportion of each mineral contained. The hardness thus indicated, however, is modified by two subordinate factors, the texture of the rock and the degree of alteration found in the component crystals. Generally speaking, a rock is hard when it is fine grained and dense in structure or when it is fresh; and conversely it grades toward the soft end of the scale when its component minerals are large and the rock mass is not so compactly constructed, or when it shows a degree of alteration. This classification is the most important in the list, and for most schedules of practice to be worked out, it will be the basic factor with all others as more or less important modifiers.

Hardness is determined in three ways, (a) by the drill-test method for underground use, (b) by the sight test with the geologic pick, and (c) by the grinding-test method for more accurate work.

The standard method for testing ground in place is to use a new Waugh 16 V stoper, drilling a hole vertically upward, through a solid block of the ground to be tested, using a 2¼-in. cross bit with 5 deg. and 14 deg. double taper, on a second length of steel (3 to 4 ft. long) and an air pressure at the face of 85 lb. Drill tests should be made through a solid block of ground, as slips and fissures will obviously affect the result—in some classes of ground two or three holes will sometimes be drilled before the operator will be satisfied with the figures, and sometimes it is well to take the average drilling speed of two or three tests as the final result.

By the older method described above, from which this procedure is taken, the linear inches drilled per minute was used to designate the hardness of the ground. The new procedure calls for a calculation of the cubic inches of rock removed during the test period, and this figure divided into the total foot-pounds of energy developed by the drilling machine during the test will

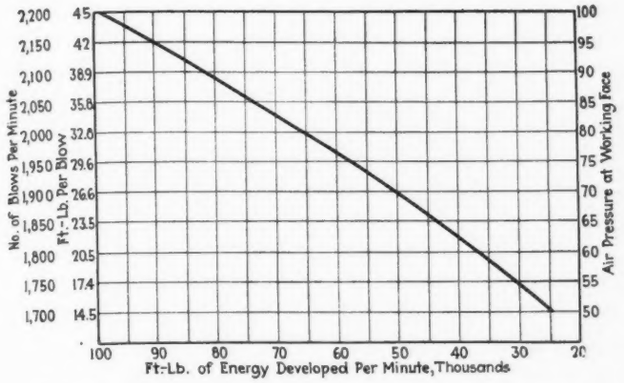


Fig. 2—Engineering rating of a 16 V stoping drill

give the foot-pounds of energy necessary to drill 1 cu.in. of rock, from a solid mass into drill cuttings. It will be clear that when this procedure has been adopted we can do away with a standard test drill, and use any drill, at any air pressure, with a cross bit of any size, provided only that we know the rating of the drill used at the air pressure available, either through manufacturers' tables in the case of a new drill, or by shop test figures in the case of drills more than six months old. Care is required to see that the drill steel is sharpened with a cross bit, that the steel is three to four feet long, and that the hole is drilled vertically upward or nearly so. In this way the weight of drill steel reacting against the hammer of the machine, the effect of friction of the drill steel against the side of the hole, and the cutting action of the drill bit will be nearly the same in all test work.

Fig. 2 gives in graphic form the manufacturers' rating of the 16 V stoper, and the foot-pounds of energy developed per minute under the various air pressures. Fig. 1a is added under Fig. 1 to show that the older classification, using linear inches drilled as the rating figure, did not have a uniform increment in the different classes. and that the smallest increment was at the soft end of the scale, where we would least expect it to be. In other words, the closest division of the ground was made at the soft end of the scale, while at the hard end, where one hole less in the round, or carelessness in placing the holes, would be most effective in spoiling the round, each standard round was designed to be effective within a range more than ten times greater than at the soft end of the scale. Fig. 3 shows the new hardness scale, based on the foot-pounds of energy required to drill 1 cu.in. of hole, and using a constant increment within the range of any one class of ground. The number of classes is dependent upon the number of standard rounds needed to drill most economically in the entire range of ground, and will probably vary as new types of machines are invented, more effective explosives introduced, and as the efficiency of mucking is increased by the use of mechanical means. Fig. 3a below Fig. 3 indicates how a ground classification will be applied to the work of drilling drift rounds in the various classes of ground, no account being here taken of corresponding powder allowances.

Ground tested by the drill-test method will be classed as A, B, C, D, and so on, the limit of each class being determined by the single standard round which will be most economical within the entire range of that class. When ground has varied in character in either direction along the line of Fig. 3, so that it is within the economic range of another type of drill round, of different depth and number of holes, and a different powder allowance to obtain the same character of muck pile, it should be included under a different class letter as shown.

During the progress of drill tests, sight tests should be made with a geologic pick. In the course of a few weeks, the drill test can be dispensed with, except as an occasional means of checking figures. A fair observer can become proficient with the pick.

The rock cuttings from the test portion of several representative drill holes in each class of ground should be saved, dried, screen analyzed, and weighed, and the sum of the reciprocals of the mean diameters obtained. The purpose of this screen analysis will be dealt with later, in the second installment of this article.

A representative sample of each class of rock submitted to the drill test should be tested in a small grinding machine, following exactly the method outlined by Lennox. By such procedure, a grinding resistance figure can be given to each class of ground encountered in the mine. Lennox apparently arbitrarily took the grinding resistance of Portland (Cripple Creek, Colo.) ore as being unity, and as Portland ore was neither the hardest nor the softest among those he tested, some of his grinding resistance figures ranged above, and some below, unity. It is recommended here that the hardest rock in the drill test classification scheme (A+) be given the grinding resistance rating 1.0 and that all other classes will then be rated as some decimal part of 1.0 as in Fig. 3.

3. *The Degree of Toughness or Friability of the Rock* —A rock is tough when it is fresh, fine grained, and massive in structure; and it is friable when altered, coarse grained, and loosely constructed. The degree of toughness, then, depends so far on the identical characters that are observed for the degree of hardness

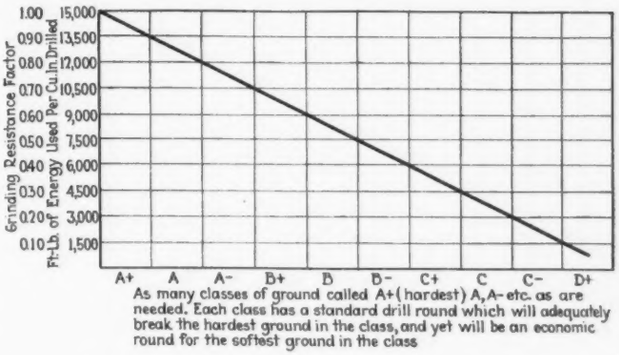

Grinding Resistance Factor
Ft-Lb of Energy Used Per Cu.In.Drilled
A+ A A- B+ B B- C+ C C- D+
As many classes of ground called A+(hardest) A,A- etc. as are needed. Each class has a standard drill round which will adequately break the hardest ground in the class, and yet will be an economic round for the softest ground in the class

Fig. 3—Proposed scheme of classification

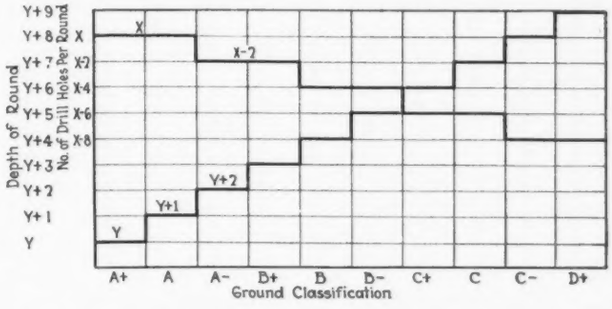


Fig. 3a—Application of hardness classification to the problem of drift rounds

(2), and except for one possibility (3) could be eliminated from this schedule. It seems to be the case, however, in many studies made thus far, that there is a relation between the toughness of a rock and the percentage of iron and basic minerals that it contains. Those rocks that are the most basic in composition have largely been the toughest to break, whereas those that are the most acid, and have contained the most silica, although of apparently the same hardness, when subjected to a drilling test, have been brittle and easy breaking. If this observation proves to be generally true, the classification for toughness (3) will be of importance in this schedule, and will depend largely upon the rock type for its main valuation, with the rock texture, and the degree of alteration, acting as modifiers.

For the purpose of this classification, little difficulty should be experienced in dividing rock into its main types, as granite, andesite, diorite, basalt, limestone, sandstone, quartzite, and the like. This will be done by a sight examination. The rock type name will serve well enough to give an index to the relative amounts of silica and iron or base contained. Each rock type will also be classed for texture as fine, medium, or coarse grained, depending upon the size of the ground crystals. In a tentative schedule, the following arbitrary limits have been placed on crystal sizes: Crystals averaging $\frac{1}{8}$ in. in diameter or under will be fine; from $\frac{1}{8}$ to $\frac{1}{4}$ in. medium, and over $\frac{1}{4}$ in. will be classed as coarse. The coarser grained a rock is, the more pronounced are the intercrystal planes, and consequently the more tendency there is for the rock to show signs of weakness along these planes. In fine-grained rocks, the minerals are more likely to be intergrown, and consequently the rock will be more massive in structure and harder to disrupt or crush. The remaining modifying factor is the degree of alteration in the rock, and will be a sight classification into the three divisions—fresh, partly altered, and completely altered. Alteration progresses along intercrystal faces, as well as by the development of intracrystal planes of weakness, and the tendency is for the rock mass to become softer along these planes, and more easily ruptured. A simple and fairly accurate way to determine the degree of alteration of an igneous rock, for the purpose in hand, is to determine the degree of alteration of the feldspars, and to class the rock mass accordingly. The degrees of toughness are expressed in twenty figures, from 1.00 to 0.81 by increments of 0.01. The toughest rock is classed as 1.0 in this schedule and will be of highest iron and base content, fine grained, and fresh. The most friable rock is classed as 0.81 and is of lowest iron and base content, coarse grained, and the feldspar minerals are completely altered. At a later time it will be quite feasible to combine these gradations so that one powder allowance, for example, will do for a range of several, and it is felt that eventually not more than three to five powder allowances will amply suffice to cover the full range of toughness, under one hardness classification.

To be continued

Production and Uses of Electrolytic Iron

For millenniums, man has used fire for extracting iron from ore, says Charles P. Perin in *Research Narratives*. To bring together ores, fluxes, fuels, and other supplies at suitable places in quantities to satisfy modern needs necessitates transportation on a prodigious scale. But there are huge deposits of iron ores remote from fuels, yet relatively near regions of large potential demand for iron and steel and not far from waterfalls by which electricity could be generated cheaply.

Also, of the iron and steel produced by so great expenditure of energy, 20,000,000 tons are estimated to slip away each year by corrosion. Not only are expensive finished products lost, but the indirect costs are very great for temporary prevention, repairs and replacements. Furthermore, discarded iron objects, from cans to automobile bodies, are increasingly disfiguring the countryside, especially in proximity to communities. Could not large tanks of iron solvent, ferrous chloride, for example, be maintained in convenient places, into which these wastes could be dumped? Then the iron could be recovered by electrolysis.

Many patents relating to electrolytic iron have been issued in various countries. A few years ago, the most successful concerns in France and the United States combined forces. In America the Niagara Electrolytic Iron Co. has rehabilitated a chemical plant recently purchased at Niagara Falls and is commercially producing iron of a purity of 99.96 per cent while continuing research and development. This iron is resistant to corrosion and has good physical qualities.

The process begins with large bars of cast iron, which, as anodes of huge batteries, are dissolved in the electrolyte of ferrous chloride. From this solution the current deposits the practically pure iron on the cathodes, which are long, thick, hollow steel cylinders with smooth surfaces. The cathodes are revolved slowly and the electrolyte is kept in constant circulation through the battery cells, or tanks. These cells are of reinforced concrete impregnated with 5 per cent of sulphur.

On each cathode the electric current builds a seamless tube of iron ordinarily $9\frac{1}{2}$ in. internal diameter and 13 ft. long, of any thickness desired, up to $\frac{1}{4}$ in. Diameter and length of tube can be varied using cathodes of different sizes. Thickness depends upon time and current. The initial deposit is full of hydrogen, which embrittles the iron; therefore, the cathode and the adhering tube, upon removal from the battery, are passed through an oil-fired annealing furnace, which removes most of the hydrogen.

For removal from the cathode a special stripping machine is used which enlarges slightly the diameter of the tube by kneading the iron between the cathode and three rolls which are forced against it by hydraulic pressure. Then the tube is further annealed in an electric furnace. The cathode is returned to the battery. The electrolyte is generated in special tanks by aid of steel scrap and is used continuously.

By slitting, flattening, and rolling, the tubes may be converted into plates of any desired thinness. Or the tubes may be slit into narrow strips or into coils for drawing into rods and wire.

Seamless tubes for steam boilers, condensers, evaporators, and oil-cracking stills may be made to advantage from this iron; also containers for compressed gases, automobile mufflers, paper-mill rolls, deep stampings, and many other articles for which great purity, malleability, ductility, or resistance to corrosion are desired.

Problems of the Mine Operator in Tropical Countries

By Charles Butters

THE San Albino gold deposits are located in the Department of Segovia, in the northern part of Nicaragua, at an elevation of 1,600 ft., set among hills with elevations up to 3,000 ft.; and in Murra, 10 miles away, where elevations reach 5,000 ft. The country is covered with oak and pine, and in the valley and gulches tropical hard woods occur. The gold occurs in association with pyrite in flat siliceous veins in schist.

The road from Leon is nearly 200 miles long and is easily covered in six days by mule. A good cart road has been built by the interests with which I am associated, assisted by the Nicaraguan Government which gave $10,000 toward the building of the last 90 miles, which cost $35,000. Nearly all of this road can now be used by small automobiles quite comfortably. Cars of various kinds are now running between Ocatal and San Albino over a fair road, negotiating the 45 miles in two and a half hours, against nine hours on muleback. Eventually cars like the Ford will be used to a considerable extent, and by degrees the roads will be gradually improved, as the people are beginning to see the value of good highways.

When construction was suspended, three years ago, we had on hand 1,600 bags of cement, worth $10,000, and I did not know how long the shutdown would last. The problem of carrying the cement was a serious one, because the plant is situated on the bank of a river where it is foggy and damp in the rainy season. I bought the cement from the Mount Diablo Cement Co., in California, and realizing the difficulty of transportation to the property over 200 miles of road, partly in the rainy season, I took great care in packing it. Three bags were used: First, a paper sack; second, an ordinary cement sack dipped in coal tar thinned with benzol; third an untreated cement sack. The dipped sacks were run through a rubber hand clothes wringer and put in the sun to dry. This was done at my Oakland laboratory, the tarred sacks being then sent to the cement manufacturer, who put the tarred bags inside an ordinary cement bag, and then the paper bag inside the tarred bag. The tarring makes the bag harder and more easily torn. The ordinary bags were used to take the wear and tear and paper bags gave an elastic inner container, dust-proof, and to some extent moisture-proof and air-proof. Now, three years after shipment, this cement is going in construction in first-class condition. Two small lots were stored in dry warehouses, one in Leon and the other in Pueblo Neuvo, on the road. These lots turned to stone, notwithstanding the fact that they were kept dry and had been exceptionally well packed.

At San Albino we did something else. The bagged cement was put in a planked-up bin in the mill. The bin was lined with 3-ply tarred paper and as the bin was being filled unslaked lime was spread over each layer. Finally on top one foot of lime was placed as a cover and tarred paper was put over the lime. This cement kept perfectly because it was almost hermetically sealed. The lime used is still good air-slaked lime and is being used now after three years.

About fifteen tons of lime that had been exposed for three years to rain and sun we are utilizing in the following manner: I ground this through a small Hardinge mill into a putty with which to build the foundation for a 40-ft. thickener tank situated on a steep hill and containing over 2,000 cu.ft. of rubble masonry. The old lime, ground fine, made first-class mortar, and the masons use as much mortar as rubble.

An alternative to shipping finished cement is to ship it in the form of clinker. It keeps indefinitely, generally improving. For a year it can be kept in the open. Water does not affect it, and if it is packed in cement bags there is no loss in dusting and no loss by getting wet, and the packing is cheap.

When cement is required the clinker is ground dry with 5 per cent of gypsum, and to this 10 per cent of *dry* thoroughly slaked lime may be added. These may all be ground together in any small ball mill, followed by a small tube mill made from pipe, 20 in. diameter and 6 ft. long. The mixture should be ground to about 150 mesh, without sifting or classifying by air.

Gypsum can be carried in stock at a mine store and is imperishable. Accordingly, a mine in the backwash of civilization can carry clinker and gypsum; if it can get lime it can be slaked and dried and packed in barrels lined with paper and kept almost indefinitely.

Where you have lime and clay you can make cement, but it requires skill and it is not easy to get a high enough temperature to make clinker with wood as a fuel. We made portland cement in a small experimental plant at San Albino which tested as high as the imported cement. The plant was a miniature portland-cement plant designed to make fifty bags of cement per day. The furnace was 3 ft. inside and 12 ft. long and was charged intermittently like a Brückner cylinder. But to get the temperature required to make good clinker took too long, with the result that the capacity came down to only fifteen bags per day, and although the cement was satisfactory the cost was the same as the imported product—about $6 a bag or $25 per barrel.

By not trying for such a high-test product cement can be made here for about $25 a ton as soon as our mill is completed.

In the tropics I have found tarred paper (three grades, 2-ply, 3-ply, and 4-ply) a very useful article in the store. I have used it in storing corn. Just at present we have a famine in corn in northern Nicaragua. Corn is ordinarily worth half a cent a pound. It is now selling for 4c. a pound. We saw this coming and laid in corn for seven months at a cost of 2¼c. To preserve this corn from the weevil and from mold, I built a bin of rough planks, 12x12x10, lined it and covered it with single-ply tarred paper. Every four weeks, if the corn is dry, I place a dish with a quart of bisulphide of carbon under the paper on top of the corn. The vapor, being heavier than air, sinks and destroys all insects. If the corn is damp when received it must be dried before it is put away. I have taken old, damp mud houses, with brick or tile floors, and lined the floor and walls with 2- or 3-ply paper and kept the corn in good condition all through the winter season.

Another article of the same kind that I have found useful is the heavy tarred roofing paper. We live in rough board houses. Our floors are hand sawn plank about 1¼ in. thick and put down green. We had no time to season the timber. The tarred roofing is laid down over the rough flooring like linoleum, covering the cracks and making a finished floor, proof against fleas

and ticks. It is an air-tight and moisture-proof floor cover.

Transporting the shell of a 5-ft. Allis-Chalmers ball mill weighing 1,000 lb. to San Albino over 200 miles of road cost by contract $150, or 30c. per ton-mile. I considered it a reasonable charge. The wooden cart, built especially, tipped over repeatedly and three new wooden axles were cut in the woods on the way up. To reload, a hole is dug in the road, one of the low wheels is dropped into the depression, and the cylinder is rolled sideways over the wheel onto the cart body.

An ordinary load in Nicaragua, for four good oxen, is 2,000 lb. Four oxen cost from $80 to $100 and a strong cart costs $25. The value of this kind of transportation is that a good axeman can immediately replace any broken part from the forest. A worn-out ox can be turned out to pasture and sold for $15 to $20, so the depreciation on motive power is about 25 per cent after five years' use, while maintenance still preserves your cart. No mechanical form of freighting can show a figure equal to that. Gasoline for trucks has to be imported; the ox-freighter finds his "fuel" on the roadside for one-half the year.

St. John del Rey's Labor Problem

The following remarks from the annual report for 1925 of the St. John del Rey Mining Co., Ltd., mining gold at Morro Velho, Brazil, give an interesting picture of labor difficulties there.

At least 1,100 men are required underground during the time that present work, so long standing, is being undertaken, even taking into account the saving in men already effected by such labor-saving devices as have been installed. It will therefore be seen that in the most favorable period of the year the underground force was still too low by about 240 men.

In December, 1924, when a rise in pay became inevitable owing to the increased cost of living, it was decided to give this in the form of a special monthly gratuity for twenty-four days' full work, as an increase to the standard rate of pay would not necessarily have brought about an increase in the number of workmen.

During the months of January and February, when the force is invariably higher than at any other time of the year, the result of this system of payment could not well be judged, but throughout the dry season, when the demand for labor in the States of Minas Geraes and São Paulo has been even more in excess of the supply than was previously the case, the company has maintained a slightly larger force than during the same period of the preceding year. There is no doubt that this has been largely attributable to the cash payment of 48 milreis (54.6c. = 1 milreis), received by each man who works twenty-four full days, and the experiment of increasing the workmen's pay by this system has therefore proved to be a success, though it must be admitted that the type of labor in the mine is inferior to what it was even a year or so ago.

Attempts to obtain European miners for Morro Velho at the standard rates of pay had previously ended in failure, but it was ascertained that the fluctuating Brazilian exchange had something to do with Europeans being unwilling at that time to accept payment in Brazilian currency, and the management was informed that an offer in the currency of the countries from which miners might be obtained would probably result in men coming to Morro Velho. This experiment has been tried, and in due course fifty-seven Portuguese were sent to Morro Velho. Between the time that the men were engaged and their arrival in Brazil exchange had risen, and in consequence most of them immediately demanded a high rate of pay in milreis, higher in fact that any wages paid in the mine, and as there was an immediate prospect of losing most if not all of the men, who had been sent out at heavy expense, it was necessary to meet them to some extent, and a rate of pay in milreis was finally agreed upon, which nevertheless was more than the equivalent of what had been promised to them when they were engaged in their own country. The greatest precautions were used to avoid losing men in Rio and on the journey to the mine, but in spite of everything that was done a certain number deserted. The best of quarters had been arranged for the newcomers, who were placed under tried Spanish foremen in the best and easiest places in the mine; in fact, everything possible was done for their well-being and comfort; nevertheless, on the first day twelve refused to go underground, stating that they did not intend to work in the mine. They were at last induced to do so, but, after a single shift, left without any warning whatever and have not since been heard of.

It has always been borne in mind that the skilled men of the mine, carrying out dangerous operations and responsible for the direction of the various gangs of general miners, would require an increase of pay, to place the rate earned by them slightly above that earned by the new men (whom they would have to direct), and the feitores and pinchers received a rise of 1 milreis per day.

The men who had been sent out gave every appearance of being just what the company required, strong general mine labor, accustomed most of their lives to mining work in Spanish mines; there were no skilled men among them, but as strong general mine labor is what the company requires at present (there being a sufficiency of skilled men in the existing force) this constituted no objection.

Unfortunately, by the end of November all but six of the fifty-seven Portuguese who had been sent out had left, most of them giving little or no reason for doing so, and it became apparent that they never intended from the first to remain long with the company. In all the larger cities there are considerable Portuguese colonies. Many of the men recently sent out appeared to have relations in the country, and there is little doubt they merely took advantage of the free passage to Brazil that was provided for them.

This matter is referred to at some length to show how hopeless at present the company's chances appear to be of increasing its mine force with men recruited in Europe, for in spite of every effort (and the greatest efforts have been made by every member of the company's staff concerned) the recent experiment has resulted in an almost complete failure.

The position as regards labor in Brazil remains unchanged. Recent attempts to recruit in São Paulo have given negative results; and the mine force in December, 1925, was little different from that of December, 1924, and was quite inadequate for the mine's requirements.

Microscopic Features of Sullivan Ore

Remarkable British Columbian Mine Yields Intimate Mixture of Galena, Sphalerite, Pyrrhotite, and Pyrite—Almost No Gangue Material

By G. M. Schwartz
Department of Geology, University of Minnesota, Minneapolis, Minn.

RECENTLY the mineralography laboratory of the University of Minnesota received large typical specimens of ores from the Sullivan mine, situated at Kimberley, British Columbia, through the courtesy of E. J. Montgomery, general manager for the Consolidated Mining & Smelting Co. of Canada. The importance of the mine as one of the world's largest producers of lead, in addition to large amounts of zinc and silver, as well as the unusual nature of the ore, led to a detailed study of the ores received from Mr. Montgomery and of other specimens available in the laboratory collection. I also had the advantage of studying many thin sections of drill cores from exploration in the region carried on by R. M. Bennett and associates.

So far as I am aware this type of ore has not been completely described from a microscopic point of view. The association of large amounts of galena and pyrrhotite is worthy of special note. These minerals are not commonly associated, and this is the only large deposit where both form an important constituent of the ore. Cassiterite is also found in the ore in amounts sufficient to warrant concentration. Pyrrhotite and cassiterite are characteristic of the deep-zone or high-temperature type of deposit. Galena normally occurs in deposits formed under less intense conditions of temperature and depth; in other words, in a zone farther from the parent magma.[1] An explanation of this occurrence is suggested by a study of the textures and structure of the ores as may be best observed by a microscopic study of polished surfaces.

Summary of the Geology of the District and Mine

The geology of the area in which the Sullivan mine is located has been fully described by Schofield.[2] Kimberley is located in southeastern British Columbia near the international boundary. The Purcell range is the chief topographic feature of the region. The principal rocks of the area belong to the Pre-Cambrian Purcell series. Cambrian, Devonian, and Mississippian formations and probable Jurassic intrusives are also found in the Cranbrook area. The rocks immediately connected with the Sullivan ore deposits are of the Purcell series.

The ores occur in the Aldridge formation, the lowest exposed in the region. It consists mainly of dark gray, argillaceous quartzites, purer quartzites, and argillites, with some conglomerate. According to Schofield, the formation is homogeneous and is roughly estimated to have a thickness of 8,000 ft. exposed. Quartz and sericite are the abundant minerals. The formation is intruded by granites and by the Purcell sills, which vary from gabbro to granite. The area is much folded and faulted, as would be expected from its location.

At the Sullivan mine the quartzites strike north and south and dip to the east from 10 to 60 deg. Schofield[3] describes the occurrence as follows:

"The orebody conforms in dip and strike with the quartzites and cannot be called a true fissure vein; but a replacement deposit in which the sulphides replaced the fine-grained quartzites. The hanging wall and footwall are not well defined and the ore grades gradually into the country rock, except where the country rock consists of thin-bedded slaty quartzites which are evidently difficult to replace.

"The orebody is arranged in distinct zones, which grade imperceptibly into each other. The center of the lode is occupied by a fine-grained mixture of galena and zinc blende, in which masses of purer galena occur as large lenses. . . . The gangue in this inner zone is absent except for a few idiomorphic crystals of a pink manganese-bearing garnet. This inner zone passes exteriorly into a fine-grained mixture of pyrite, pyrrhotite, and zinc blende, which contains as a gangue numerous crysta's of an almost colorless garnet with some grains of actinolite or possibly diopside."

A very interesting account of the history and development of the mine has recently been published by the engineers of the Sullivan mine.[4]

Four large specimens were supplied by Mr. Montgomery as typical of the ores. One of these appeared in the hand specimen to represent nearly pure sphalerite, (variety, marmatite); another galena; another pyrrhotite, and the fourth an intimate mixture of all three. Other specimens at hand proved to be similar, except one in which pyrite took the place of pyrrhotite and another which was very perfectly banded.

The ores are remarkable for their mineralogical simplicity. Under the microscope the following ore minerals were identified: galena, sphalerite, pyrrhotite, pyrite, and chalcopyrite. Cassiterite occurs in the ore, as noted above, but was not recognized in the ores studied. The first three minerals composed over 99 per cent of the ores at hand. Pyrite was abundant in one specimen and chalcopyrite was found only as microscopic grains sparsely distributed in sphalerite and pyrrhotite. Pyrite is abundant near the surface, but pyrrhotite is important at depth, according to Schofield.

All of the ores show rather characteristic textures, and these seem to prevail in specimens in which one mineral greatly predominates over the others as well as in specimens which are intimate mixtures of all three.

The textures indicate that pyrrhotite and sphalerite crystallized at about the same time. In the specimens in which sphalerite predominates, pyrrhotite occurs as irregular and as elongated lath-like areas (Fig. 1). This obviously is an essentially contemporaneous arrangement. Etching indicates that the lath-shaped grains either penetrate the sphalerite along grain boundaries or along cleavage. In specimens in which pyrrhotite predominates, the sphalerite occurs as irregular areas (Fig. 2), but not as lath-like blades, for

[1] Spurr, J. E.: "The Ore Magmas." New York, 1923. Emmons W. H.: "Primary Downward Changes in Ore Deposits." *Trans.* A.I.M.E., Vol. 70, p. 983, 1924.

[2] Schofield, S. J.: "Geology of the Cranbrook Map-Area, British Columbia." Geological Survey of Canada, Memoir 76, 1915.

[3] *Op. cit.*, p. 131.

[4] Can. Inst. of Min. and Met. Bull. 146, pp. 401-465, 1924.

Micrographs of Polished Surfaces of Ores from the Sullivan Mine

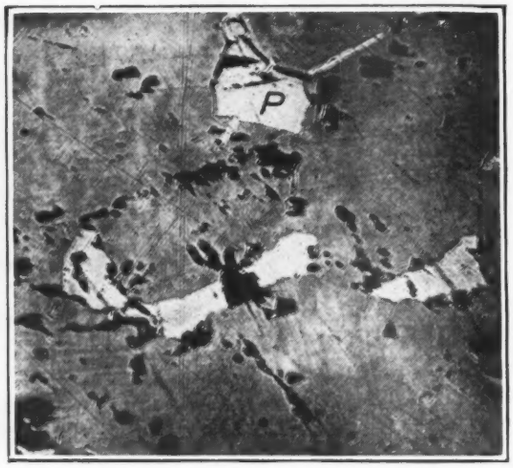


Fig. 1—Angular inclusions of pyrrhotite (P) in sphalerite. Note long lath of pyrrhotite in upper right-hand corner. These are common and follow cleavage or grain boundaries in sphalerite. Mag. X 50

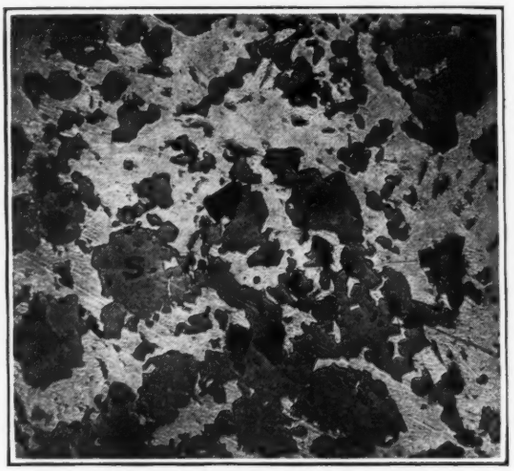


Fig. 4—Corroded remnants of sphalerite (S) in galena. The rounded nature of the sphalerite is more pronounced where it is less abundant. Figs. 3 and 4 indicate the probable later age of the galena. Mag. X 50

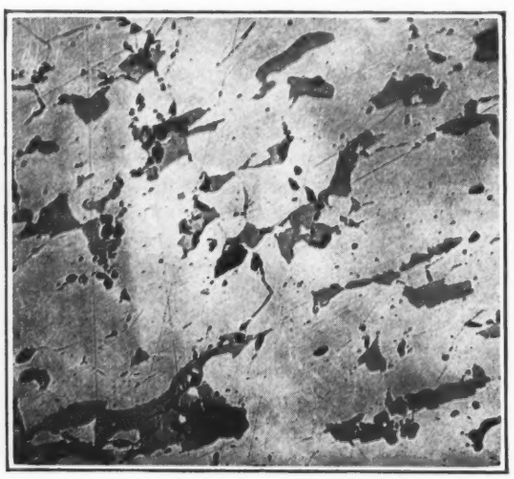


Fig. 2—Angular inclusions of sphalerite (S) in pyrrhotite. Note the similarity to A. This relationship is interpreted to mean the contemporaneous deposition of the two minerals. Mag. X 50

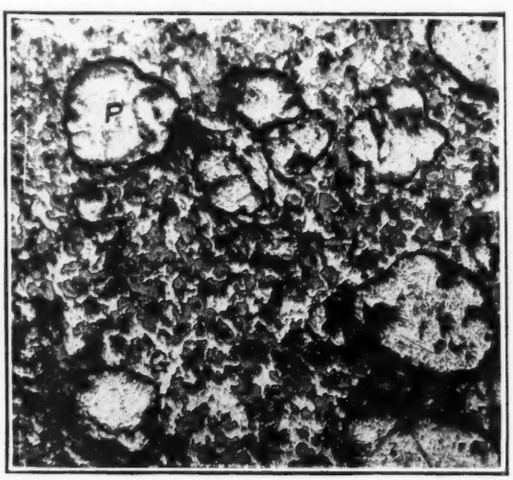


Fig. 5.—Rounded grains of pyrite (P) in a mixture of galena (G) and sphalerite (S). Pyrite is perhaps the earliest mineral, as is discussed in the text, p. 377. Mag. X 50

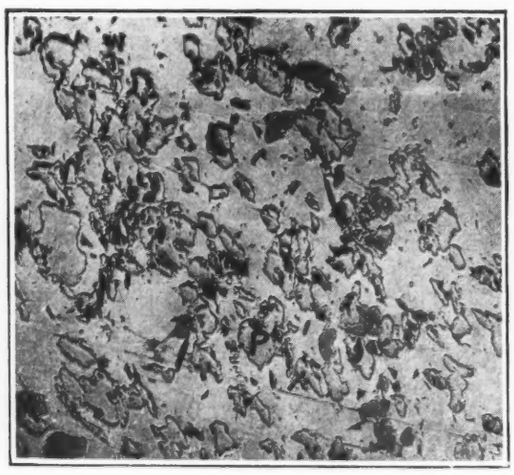


Fig. 3—Corroded remnants of pyrrhotite (P) in galena. This is a very characteristic occurrence. Mag. X 50

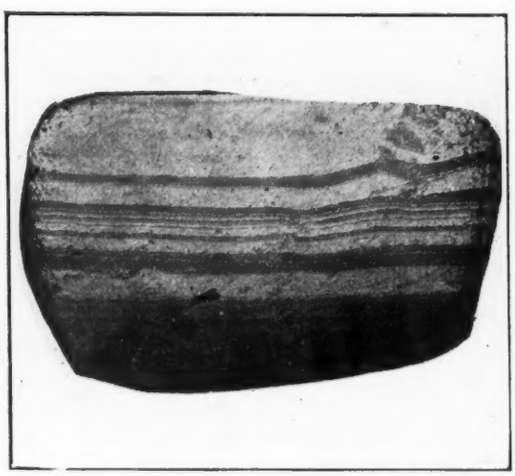


Fig. 6.—Polished surface of banded ore. White is galena. Dark is sphalerite. Both contain pyrrhotite inclusions too small to show. Natural size.

pyrrhotite does not show well-developed cleavage, as does sphalerite. There seems to be no texture or relationship which would indicate that the two minerals were not deposited simultaneously.

In the case of galena, there is abundant evidence that at least the greater part of the mineral entered and crystallized later than either pyrrhotite or sphalerite, which are found in galena as rounded, obviously corroded remnants (ice-cake structure). This characteristic texture is found not only in the ore which is predominantly galena; but in every specimen in which galena occurred as large enough areas, remnants of pyrrhotite and sphalerite were found (Figs. 3 and 4). In several specimens very small areas of galena occur as irregular inclusions in sphalerite and pyrrhotite. This suggests the possibility that small amounts of galena may have crystallized simultaneously with those minerals. There is no doubt, however, that nearly all of the galena crystallized at a distinctly later time.

Many of the specimens show more or less banding, and one of those available shows the original sedimentary banding most beautifully preserved (Fig. 6). The specimen consists of alternate bands of galena and sphalerite. Pyrrhotite occurs as inclusions in both, but far more abundantly in the sphalerite bands. This would be expected if, as indicated above, sphalerite and pyrrhotite are essentially contemporaneous. Why the bands should be so sharply differentiated is not obvious, but it is possible that sphalerite, entering first, was deposited along the more easily replaceable bands and the galena-bearing solutions were forced to replace the remaining bands. In any event there is a very sharp distinction between bands of the minerals.

Pyrite is mentioned as a rather important mineral of the deposit, but this is mainly around the periphery and at the top. This is specifically stated as follows by the Sullivan engineers.[5]

"The ore as developed occurs in two zones which for convenience have been called the south and north ore zones. In the upper levels, between these ore zones, the replacement is composed entirely of pyrite, while in the lower workings it consists of a fine-grained massive pyrrhotite."

Pyrite assumes, in general, the same rôle as pyrrhotite. It occurs as isolated, usually rounded grains in galena and even in sphalerite, suggesting some corrosion by sphalerite (Fig. 6). Some of the grains are nearly euhedral where corrosion has not destroyed the outlines. Chalcopyrite was noted in some specimens always in small amounts and with relations suggesting contemporaneity with sphalerite, but there is scarcely enough chalcopyrite to enable one to be certain.

The ore of the Sullivan mine averages about 10 to 11 per cent lead, and 12 to 13 per cent zinc[6]. The method of concentration and history of development of the process are completely treated in the article on the mine in the Bulletin of the Canadian Institute of Mining and Metallurgy cited above. A more general description is given by Young. Selective flotation has been unusually successful. The problem is not simply one of separating the lead and zinc, but also includes the necessity of rejecting the abundant pyrrhotite and pyrite of the ore.

The photomicrographs show how intimately the minerals may be mixed. The values do, however, occur in distinct single minerals, and it is thus possible to break them apart by fine grinding. The ore is ground in ball mills so that 95 per cent will pass 200 mesh. Measurements on the polished surfaces indicate that many grains of galena, sphalerite, and pyrrhotite range down to 1/20 mm. (0.002 in.). A few are even smaller, but these would make up but a fraction of a per cent of the values. Fine grinding is necessary not only to separate the grains of the individual minerals, but even more to render the particles of suitable size for flotation. Thus a double service is rendered by the fine grinding. Gravity separation naturally breaks down where the ores are as intimately mixed as illustrated. This was found to be the case in the early experiments.

The texture of the ore as shown by the micrographs should be instructive in considering concentration of other ores. Similar textures may be expected to yield to selective flotation more profitably than by any other method. An ore showing the minerals intergrown in such a fine-grained mixture necessitates such fine grinding that only flotation will be effective in treating the resulting pulps.

The ore of the Sullivan mine consists of the unusual association of tremendous amounts of galena with equally large amounts of pyrrhotite and sphalerite and small amounts of cassiterite. Galena normally occurs in deposits of moderate or shallow depth origin. It is suggested that the explanation for the association in the Sullivan mine is to be found in the fact that the galena crystallized distinctly later than the other ore minerals and, at least to some extent, replaced them as is shown by the accompanying micrographs.

[5]Can. Inst. of Min. and Met., Bull. 146, p. 406, 1924.

[6]Young, G. J.: "Selective Flotation of a Complex Lead-Zinc Ore. *Engineering and Mining Journal-Press*, Vol. 116, pp. 453-456, 1923.

Four Copper Smelters Operating in Chile

Chile has been the second largest copper-producing country in the world, but now takes third place owing to the rapidly increasing African production, says the *Revista Financiera, Bursatil y Minera.* The copper bar production of Chile during 1925 was 177,068 tons, besides which, about 85,000 tons of ore, averaging well over 10 per cent, were exported to American smelters. The copper bars were produced from the following four smelters: Chile Copper Co., 99,720 tons; Braden Copper Co., 69,908 tons; Chagres Copper Co., 2,871 tons; Naltagua Copper Co., 4,569 tons.

The ores were produced from many mines in different districts of the country, though the greater part was exported from two mines, Tocopilla and Gatico, both situated in the Province of Antofagasta in the north of the country.

Only the large companies have built their own smelters. There are at present four in operation, as named above, and four smelters situated on the coast, at present shut down, at Coquimbo, Caldera, Chañaral, and Gatico.

The three first-named smelters on the coast were worked for many years as custom smelters, and shut down during the war, owing to difficulties in obtaining fuel.

Financial difficulties have prevented the Coquimbo and Chañaral smelters from starting up again. The Caldera smelter belongs to the American Smelting & Refining Co. which prefers to export its ores to the Tacoma smelter, rather than smelt in Chile. The Gatico company, which has a completely equipped coal-dust-fired reverberatory plant, has recently preferred to export its ores and concentrates rather than smelt them in its own plant.

Useful Operating Ideas

Sampling of Concentrates in Bins

By Donald F. Reed

Ore-Purchasing Agent, The Southwest Metals Co., Humboldt, Ariz.

The Southwest Metals Co., operating a custom copper smelter at Humboldt, Ariz., closed down in 1924. During the shutdown period the company leased its concentrator to the United Verde Copper Co., Jerome, Ariz., for the purpose of making an experimental test run, preliminary to construction of a concentrating plant by the last-named company. In the course of this test run about 1,300 tons of flotation concentrates were produced and stored in the Southwest Metals' bins at Humboldt. When the Southwest Metals resumed operations, in 1925, it agreed to purchase these concentrates from the United Verde Co. It therefore became necessary to determine the tonnage and grade of the concentrates. This was done by sampling with a pipe and auger.

The pipe-and-auger method of sampling finely ground material is not new. The unusual feature in this case lay in the fact that not only the grade of the material was ascertained, but the specific gravity and tonnage of the concentrate as it lay in the bins were also determined directly from the sampling. Sampling was done under the supervision of D. F. Reed and W. C. Goeglin, of the Southwest Metals Co. and was watched and checked by A. L. Reese, O. E. Young, and J. Burkett for the United Verde Co.

The capacity of each bin was first determined by careful measurement. As the bins were full, it was necessary to take the measurements on the outside of the bins, allowing for the determined thickness of wall and floor plates, slope of bottoms, and volume of louvres. Deductions were then made for known voids in the tops of the bins. These were determined by measurement and inspection.

The weight of dry material per cubic foot was then found by sinking holes of known diameter and depth to the bottom of each bin, carefully removing, drying, and weighing all of the material from each hole. As this was weighed before and after drying, the percentage of moisture was thus found.

Then the weight of dry material per cubic foot may be designated as $W = \frac{4M}{\pi D^2 \times H}$

Where M = Weight of dry material taken from pipe.
D = Diameter of pipe (feet).
H = Depth of hole (feet).

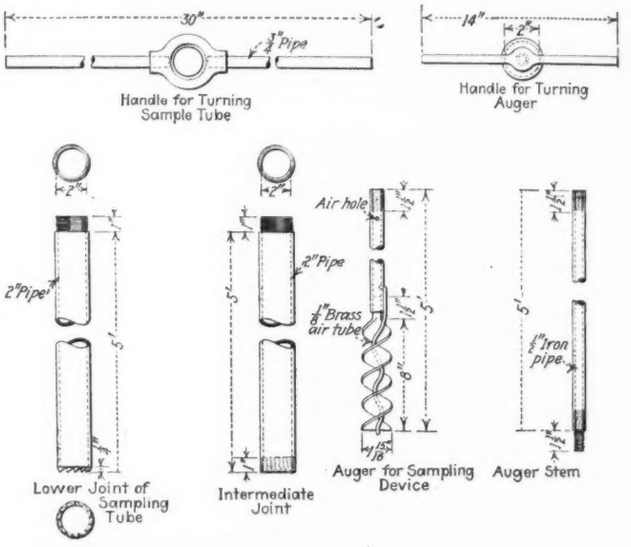
As a pipe exactly two inches in diameter was used, this formula resolved itself into:

$$W = \frac{45.87\,M}{H}$$

The material taken from the pipe was then made up into pulps for assaying in the usual manner.

The concentrates were in three separate bins and a pile on the distributing floor. They were therefore sampled and considered as four lots, four samples being taken in each of two bins, two samples in the third bin, and two samples in the pile on the floor. In calculating the contents of each lot, an average was taken of all the samples in that lot. With the dry weight per cubic foot and the volume of each lot known, the tonnage was then computed. An average of the assays in each lot was then taken and the metallic content calculated.

The samples did not check very closely as to weight of material per foot, nor was it expected that they



Sketch of pipe and auger for sampling fine material

would; as the material was in some places noticeably denser and more compact than in others, the moisture content varied, and there were undoubtedly air spaces and voids throughout the mass. The moisture content varied from 6.62 per cent in one lot to 14.31 per cent in another, the other two lots containing 10.94 per cent and 11.50 per cent moisture respectively.

Final results gave a total of 1,337.556 dry tons, containing 32.016 oz. of gold, 2,530.83 oz. of silver, 298,899 lb. of copper, 8.97 per cent "insoluble," and 31.75 per cent iron. The gross value of these metals as determined by this sampling checked within less than one-half of 1 per cent of the value as calculated from the metallurgical reports on the mill operation.

This method could be used to sample any fine-grained material, such as concentrates or tailings, in either bins, ponds or piles, and affords a much closer check upon tonnage than usual methods of estimation. The accuracy depends upon the number of samples taken and the care in estimating the volume of the material sampled.

The sampling was done with a wrought iron pipe of uniform inside diameter of two inches. This pipe was in five-foot lengths, to enable the samplers to handle it

within the confines of the distributing floor. The ends of each section were threaded so as to connect with other sections. The first section of this pipe was beveled and serrated on the bottom end to facilitate its cutting down through the material. A detachable handle with which to turn the pipe was provided.

The core or material from the inside of the pipe was removed by means of an ordinary wood-auger attached to a rod of the same length as the pipe, a section of this rod being added each time a section of the pipe was added. This auger was of such a diameter as to fill the pipe entirely, leaving only enough clearance between pipe and auger to permit the removal of the latter. The length of the rod was such that the cutting edge of the auger was always exactly even with the cutting edge of the pipe. A detachable handle for the auger was also provided.

In order to be sure of obtaining all of the material within the pipe, it was found necessary to keep the auger turning faster than the pipe. It was also found that the core had to be removed from the pipe every six to fourteen inches, depending on the compactness and wetness of the concentrates. In the wetter material, the friction on the sides of the pipe, and the vacuum produced when the auger was withdrawn, pulled all of the core off of the auger except that carried in the spiral of the auger itself. To reduce this tendency, a small brass pipe of approximately $\frac{1}{8}$ in. inside diameter was run from the tip of the auger up around the spiral and tapped into the center of the hollow rod. Upon pulling the auger up, the suction cleared this pipe and allowed the air to break the vacuum.

Metallurgical Control at the Magna Mill

Metallurgical control at the Magna mill of the Utah Copper Co. comprises weight determination of ore flow, head and tailing samples, water ratio adjustments, screen analyses, moisture determinations, alkalinity determinations, flow adjustments of reagents, inspection of flotation cells, and weight determinations of concentrates. Temperature of pulp is not a factor. Sampling is by automatic samplers, which are controlled by a master timer in such a way as to make sample cuts simultaneously at all mechanical samplers. The cut is made at ten-minute intervals.

No car weights are taken, but occasionally fifty cars of ore are run over the scales and weights are taken. This quantity is run over the weightometers on the main conveyors, and readings are taken, from which a factor is calculated to correct the weightometer readings. These readings are increased about 5 per cent. A grab sample is taken at intervals during the day from the main conveyor belts as a moisture-control sample. This is crushed to $\frac{1}{2}$ in., halved, weighed, and dried sixteen hours at 105 deg. C. Thus a weight estimate corrected for moisture is obtained each day, of the ore delivered to the fine-bins. Mill heads are flotation heads, and samples of the pulp flow are taken automatically for each half of the mill. These are cut down by a splitter. This sample also is the sample used for moisture determination in the mill pulp, which approximates 18 to 20 per cent solids at the rake classifier overflow. A daily assay sample is cut from the head sample and also a portion for a composite monthly sample. Revolution counters on the feeders of each section give a fairly accurate estimate of the tonnage going to the fine-crushing division, and from these and the two daily assays of the heads the mill assay of the heads is calculated for the day. Cleaner tails join the classifier overflow reducing the proportion of solids from 18 per cent to about 15 per cent.

The tailings from each half of the mill are sampled, and likewise a sample is taken from the whole tailings stream as a check on the two large units. These are taken each shift. Partial screen analyses are made, +100, —100 +200 and —200-mesh sizes being determined. Shift samples are only screened to +100 mesh but on the daily composites the three sizes are determined.

Concentrate samples are taken each shift before the flotation froth is discharged into the thickeners. A composite is made by combining two portions from each half of the mill. This gives the final daily sample. Portions are cut out for a monthly composite sample. Heads samples are analyzed for iron and copper; concentrates for copper, iron, and insoluble, and tailings for copper. On the monthly composites complete screen analyses are run on heads, tailings, and concentrates and in the analytical work, gold, silver, copper, iron, and insolubles. In addition samples are taken from the filter cake and the thickener discharge, the latter serving to check the percentage of solids and to serve as a measure of thickening-tank conditions. On the filter-cake sample, moisture, iron, copper, and insoluble are determined, which makes possible an estimate on the amount of copper shipped in the concentrates.

The percentage of solids in the classifier overflow varies from 17 to 30 per cent, depending upon the character of the ore. On hard ores the per cent of solids increases and on soft ores greater dilution is necessary. On ball-mill feed solids range from 65 to 75 per cent and are more or less self-regulating. Experience and judgment are the important factors in controlling this feature of the mill operation.

Flow of xanthate solution is fixed, the feeder being adjusted to deliver 0.05 lb. per ton and the quantity ranging from 0.045 to 0.06 lb. per ton. Pine oil is varied to suit conditions and depends on ore. The quantity range is from 0.09 to 0.15 lb. per ton of ore. The appearance of the flotation froth is the test for these reagents.

Control of alkalinity or the maintenance of a fixed excess of alkali is the most important factor. One man on each shift tests the alkalinity each half hour, using phenolphthalein indicator and a standard sulphuric-acid solution. Adjustment of the lime feeder is made as conditions require. The water used in the mill circuit is a neutral carbonate and requires $1\frac{1}{2}$ lb. of lime per ton of ore. An excess of $\frac{3}{100}$ lb. of calcium hydrate per ton of ore, or 3/100 lb. per ton of water, is maintained. This requires from $3\frac{1}{2}$ to 8 lb. of lime per ton of ore.

How to Cut Transite Board

Transite or asbestos wood is a hard, tough material that is used for switchboards and on electrical installations generally. It is difficult to cut, but can be sawed by a hack saw, although not satisfactorily. At the Magna mill of the Utah Copper Co. an abrasive wheel 16 in. in diameter by $\frac{1}{4}$ in. in thickness ($1\frac{1}{4}$-in. bore, grit 141, grade 2, bond A3M, steel centers) is used for this purpose and has proved satisfactory. The wheel is operated at from 1,800 to 2,000 r.p.m.

Discussion

"Engineering and Mining Journal" is not responsible for statements or opinions published under "Discussion." In many cases the views expressed are diametrically opposed to editorial policy and belief. Letters will not be printed unless the author's name and address are known to the editor.

Replacement of Aluminous Rocks

THE EDITOR:

Sir—In his article on "Magmas, Dikes, and Veins," (July 24, 1926) Lindgren states, page 130:

"This proposition is advanced with considerable confidence: That aluminous rocks (shales, schists, and igneous rocks) cannot be replaced by coarse-grained quartz without leaving abundant traces by structure, texture, and relics."

Later in conclusion he makes this unqualified statement, page 133:

"It is asserted that normal, coarse-grained vein quartz cannot be formed by replacement of aluminous rocks."

My answer to these statements is as follows:

Coarse-grained quartz does replace aluminous as well as other types of rocks and may or may not leave traces by structure and relics, which traces may or may not be abundant. Rarely, if ever, according to my observation, is the texture of the replaced rock assumed by the quartz. Relics of the replaced rock are common and afford the best evidence of replacement.

Tyrrell has called attention to a clear case of replacement of greenstone (altered volcanic rock) by quartz, in the pre-Cambrian Shield region. He writes:[1]

"In the West Shining Tree country greenstones showing strongly marked ovoidal or pillow structure, similar to that so common in the amygdaloidal basalts of this district (referring to Porcupine), are particularly abundant and here and there through the greenstone quartz veins occur, some of which have been determined to contain gold. The individual ovoids or pillows are packed closely together, but there are angular portions of the greenstone in between them, and, as a rule, the rocks inside the pillows and in the angular areas outside of them are precisely similar in character. In one place, however, the angular areas were entirely converted into quartz, which, as far as I could see, was precisely similar to the quartz in the veins near by. As these angular areas had originally been greenstone, we have in them a clearly marked example of a metasomatic replacement of the greenstone by quartz, but whether the veins in the vicinity were also formed by a similar replacement or not, I have no definite proof, but I believe that replacement took a large share in their formation."

Mr. Tyrrell's experience and standing in Canadian geology leaves no doubt of the accuracy of his observation. Lindgren will no doubt readily admit that it is an absurdity to attempt to maintain that quartz was introduced into or made open spaces exactly conforming to the outlines of these angular areas; and therefore we have, in this one example, proof that quartz (typical, coarse-grained quartz, so common and widespread in the Pre-Cambrian Shield) can and does replace greenstone.

Tyrrell does not mention whether or not there was any preservation of the texture of the replaced rock, but, judging by numerous exposures that I have studied in this Pre-Cambrian area, I would venture the opinion that there probably was no such preservation. The microscopic schistosity that these amygdaloidal greenstones of the Pre-Cambrian Shield commonly have, consisting of a parallel disposition of chlorite with sericite, carbonates, and other minerals, I have never seen preserved in the quartz which has invaded them; nor have I seen preserved such coarser rock structures as fissility, jointing, or schist contortion. But in a broad sense there was a preservation of the "structure" of the rock, in the example described by Tyrrell, because the pillows of unreplaced greenstone stood out among the angular areas of quartz.

As to relics of country rock, Tyrrell states that "the angular areas were entirely converted into quartz." Perhaps a close enough search might have disclosed some residuals of the replaced greenstone, however small, isolated in the quartz. Evidently, however, they were not abundant.

A universal feature of coarse-grained quartz veins and bodies is the occurrence of inclusions of wall rock. In many instances it may be difficult or impossible to decide whether or not inclusions in these quartz bodies have been isolated by displacement (mechanically) or replacement (solution of the supporting rock substance). Proof of displacement by the injected or crystallizing quartz seems to be very rare. I have never seen such proof, nor have I seen clear-cut incontrovertible evidence in the literature. I have observed instances of coarse-grained quartz containing inclusions, with a structure discordant with the structure of the wall rock, but such phenomena could be readily explained by noting that this discordance had been produced by rock dislocation before the arrival of quartz-depositing solutions. I call attention to the fact that rock dislocation of pre- or post-mineral age may cause rotation or other dislocation of inclusions, and this must be considered and disproved before mechanical displacement by the vein substance's injection or growth can be accepted. According to my observation in the Pre-Cambrian Shield region and in the Sierra Nevada and Klamath Mountain provinces in California and Oregon, in the vast majority of instances rock inclusions in these coarse-grained quartz bodies give every indication, or strong reasons for inferring, that they were not disturbed during vein formation. If their isolation were effected by mechanical displacement, perfect balance—too perfect to be accepted as plausible—kept them immovable while the supporting rock was thrust away from them. Displacement entails the dilatation or dislocation of inclusions or wall rock, or both, as I have discussed in the case of

[1]Tyrrell, J. B., "Note on the Geology of Porcupine." *Bulletin* of the Canadian Mining Institute, June, 1915; pp. 397-8.

Porcupine.[2] It is plainly the task of proponents of displacement to point out evidence of this dilatation or dislocation, or explain the reason for its absence, if their ideas are to gain general recognition.

In the absence of evidence of displacement, attention is fixed on the possibility that these residuals of country rock, remaining as inclusions, may not be the result of the replacement of country rock by these coarse-grained quartz bodies. Full discussion of this problem is worthy of exhaustive treatment. (I hope someone fully qualified will do so.) Here I can point out only a few features.

These inclusions bear little resemblance to "a rubble-filled fissure"; they are not loose, but are welded, blended, or "frozen" to the contiguous quartz; "blended" with the quartz in some cases; so mixed that quartz and inclusions cannot be separated, or individually distinguished except by minute examination. Rarely do these inclusions show crusts or druses on their peripheries, or unfilled spaces along them. Quartz and inclusions are essentially an intermingled mass, suggestive of more than mere physical union.

Actual attack of the inclusions is frequently shown by their rounded, frayed, or indented edges, and by tongues of quartz penetrating into them and isolating segments of an inclusion. Tiny residual, isolated spots of country rock may lie inside a quartz mass, which has worked through an inclusion of which these spots were obviously once a connected part. Small isolated tongues of inclusions may be found, in alignment, and plainly cut off from one another. Some strips of inclusions ring a central nucleus of quartz. There are in some lodes literally all conceivable shapes and innumerable sizes of inclusions corresponding to the conception of arrested replacement. At Porcupine residual strips of wall rock are commonly chlorite, sericite, or a carbonaceous substance, other minerals having disappeared. Again, there may be skeleton remains of country rock when for some reason the outline is preserved, though much of the rock mass has been replaced. A deposition of pyrite selectively deposited in country rock may mark the configuration of an inclusion. A tongue of wall rock may extend into the quartz lode and be cut off from its former obviously connected portions, which now lie in a series of aligned disconnected bands, their misfitting edges plainly having undergone dissolution. The general effect on many inclusions is not unlike that of a body of land attacked and partly overwhelmed by the sea (of quartz). Though the contacts between inclusions and quartz may be sharp and distinct, frequently they are vague, sinuous, indented, or merged in a confused manner, rock and quartz forming a coherent physical unit. These features are readily explained by various stages of arrested replacement, and they are not explained by mere physical attraction, at least in many instances.

One could elaborate on many concrete examples suggesting the residual-replacement origin of many inclusions in these coarse-grained quartz bodies. The structure and form of many lodes will give the same testimony. Lindgren and others who doubt emplacement of coarse-grained quartz by substitution of wall rock are urged to study carefully the lodes of the Porcupine district, where replacement phenomena are especially well developed.

To avoid misunderstanding I should add that I have found that replacement has invariably been accompanied by fissure filling in the emplacement of coarse-grained quartz lodes and veins. In some cases evidence of controlling fissures is discernible with difficulty; in others the quartz body clearly occupies a strongly fissured zone. The characteristic habit of the quartz is to follow the more open and therefore penetrable portions of the rock. Replacement is evidently incidental to this penetration and filling of fissures. But I do not doubt that in some or many lodes more quartz has been emplaced by substitution of wall rock than by filling spaces.

ELLSWORTH Y. DOUGHERTY.

Heroult, Calif.

[2]Dougherty, E. Y. "Formation of the Porcupine Quartz Veins." *Economic Geology*, November, 1925.

Bolivian Tin Veins

THE EDITOR:

Sir—Recently the April 17 number of *Engineering and Mining Journal-Press* came to my attention, in which F. R. Koeberlin presented an exceedingly interesting article, "Geologic Features of Bolivia's Tin Bearing Veins," describing, however, particularly those in the granites and in their fine-grained equivalents—i.e., quartz-porphyry and rhyolites; and where these (veins) pass into the intruded sedimentaries, thus making no reference to the important tin producers which lie wholly in the sedimentaries—slates and quartzites. It is unfortunate that Mr. Koeberlin did not mention the country rocks in all the veins he cited: Llallagua, Chocaya-Animas, and Oruro veins are in the porphyries and intruded slates, whereas Totoral, Antequera, and Avicaya are in slates and quartzites and El Salvador in slates, while the more important producers (not referred to)—Araca, Morococala and Jatunkaka—are in slates, quartzite slates, and slates with quartzite seams respectively (where igneous rocks are not apparent today). To one unacquainted with the Bolivian tin fields the inference might have been made that the mineralizations are important only in the porphyry-intruded sedimentary rocks. Mr. Koeberlin's endeavor to "call forth comment" from those operating tin mines in other parts of the world is well worth the effort he has put in his text. I am familiar with many of the Bolivian tin fields, but lack his detailed information, and so must rely upon memory for data.

Mr. Koeberlin has appreciated the lack of chemical research to confirm his geological interpretation of the evidence he cites. It is fair to suggest that the important vein occurrences wholly in the sedimentaries should have been compared also. The Colorada vein of the Compañia Oploca, cited, is not wholly in the porphyry; the oreshoot of over 1,000 meters lies well in the intruded slates (through which the fracture passes), and there is no apparent or radical change in the type of mineralization, or width, in the transition. The Animas vein of the Compañia Aramayo Francke, where it comes in from the adjoining Oploca claim, is higher in tin and lower in silver contents close to the boundary than on the same level as one proceeds further into the Animas claim. Might this be due to a change of chemical composition in the porphyry (more acid) or is it that it is further away from the distant source of the high-temperature minerals?

The Animas mineralization is the highest-grade mixture of silver-tin that is being exploited today in Bolivia. It is essential to have chemical research done to satisfy the explanation that cassiterite is dissolved and redeposited as tin oxide at the lower levels. Mr. Koeberlin

appreciates this "essential" in regard to his concepts of "weathering"; the effect of the presence of copper also demands chemical study. Therefore his phrase on the fourth line from the bottom of page 642 should preferably read today as "*probable* natural process."

The high-temperature minerals classified by Mr. Koeberlin, compared with the low-temperature group are an important general mineralogical guide. Lack of elaborate petrographical comparisons is another essential, to which Mr. Koeberlin has also had no recourse, that is failing to back up the redeposition suggestion; perhaps with the increased activity in the Bolivian tin fields there will be more than one company (to date only the Caracoles Tin Co.) to have a geologist on its staff with equipment to follow up the lines of Mr. Koeberlin's broad concepts. To date the granites have been responsible for the smallest percentage of the Bolivian tin output (practically all from the Caracoles Tin Co.), the porphyries and intruded slates being the largest sources, and then the sedimentaries.

Heretofore the Bolivian tin mineralizations in general have not been approached with the proper commercial appreciation; the working-out of the high-grade minerals will attract the heretofore disregarded low-grade, or ore falling into the fourth class mentioned by Mr. Koeberlin, but not necessarily the redeposited type that he suggests. The possibility of commercializing the-low-grade mineralizations will be influenced by more improved mining and milling systems (higher recoveries), as well as the development of cheap power, not to disregard the probability of higher prevailing tin prices.

Mr. Koeberlin has started something of particular interest where little is known today; his efforts are most commendable. A map showing the various localities would have helped to bring out the arguments put fourth. LESTER W. STRAUSS.

Tucuman, Argentina.

Counter-current Decantation vs. Filtration

THE EDITOR:

Sir—In my Christmas letters from 1913 onwards I animadverted on the growing practice in Canada of avoiding filtration and of trusting to counter-current decantation, ("It is surely a decadent proposition," Christmas letter, 1913), when the washing method had been much more thoroughly tried out in South Africa. Neither was I able to indorse the Canadian practice of a cross between a mechanical agitator and a Pachuca tank.

It is encouraging to read Mr. Hanson's remarks in your issue of July 17, and to note that Pachuca tanks and filtration are being more and more adopted. I would like, however, to suggest greater attention to the efficiency of filtration. Probably the richest solutions ever filtered in ore treatment were those obtained in the West Australian gold fields, but it was not found necessary to adopt double filtration or even dilution of solution. The filtration method employed was that adopted also in almost every gold mine in Rhodesia, including the latest mill, the Sherwood Star. Probably in both territories the restricted amount of water available was a deciding factor; but the one filtration is highly efficient.

Tests of filtration efficiency in washing and recovery can be so easily carried out, say with salt solution, that one is surprised that so little is published on the matter. Before committing myself to filter-pressing I had carried out exhaustive tests with dyed pulps each containing a determined quantity of salt in solution. The resulting cakes were divided into many cubes, the method of the formation of the cake determined from the presence of the differently dyed materials pumped in regular sequence, and the efficiency of the washing by many separate tests taken from the surfaces and centers of each cube. The results were tabulated with colored plates and were very favorable, but the cost of publishing the colored plates was too great to make that possible.

Could we not have similar information given us by tests with an Oliver filter of the most modern washing type? Having regard to the favorable results reported from other territories, such figures could not but be helpful to the profession. ALFRED JAMES.

London.

Cause and Effect

THE EDITOR:

Sir—Your article "The St. Lawrence Earthquake" in your No. 6 dated Aug. 7th 1926—

It is implied in your article that you do not know the Correlated Cause and Effect of Earthquakes and why do you with all these Garbled inferences try to explain all about Earthquakes? You know one doing this not knowing the Correlated Cause and Effect does not know what he is talking about let alone what he is saying—

You and W. C. Mendenhall are in the same boat. I put this matter up to Congress couple days ago. Why do you do this anyway? Is it for the purpose of strengthening the ban on certain sciences and perpetuating the ridicule propaganda launched by the Tyrannical imperialistic Oligarchy and money grabber on these sciences—if not why do you do so? It appears the sole aim of this article is to bemuddle the people on these lines.

I gave you a chance to get into the Science of Earthquakes once but you turned it down. It keeps me busy with a Criss Cross Correspondence baughling these dumb heads out for putting out there rotten bunk. Your and Mendenhall's Cases are parallel with the case I am going to cite you, for you and him are working in Collusion—Mendenhall says the East is safe from Earthquakes. I say he don't know.

May 8th 1902 7.30 A.M. Mount Pelee was seen in eruption a whirlwind of fire burst forth from side of the mtn., and St. Pieree burst into flames and 30,000 people hurled instantly into eternity — explosions sounded as if the Navies of the world in a Titanic Combat.

Science notified the committees of authorities in Martinque of the coming of this St. Pierre disaster But these authorities pronounced against the idea of danger and the inhabitants relied upon the judgement of the authorities and remained to perish in the awful eruption that followed.

The way Mendenhall is shooting off he is placing thousands and likely millions of people in jeopardy of their lives for he is taking the place of the authorities of Martinique when he don't know a —— thing about it.

Its strange you fellows will take such a stand as this. I can't see why. Yours truly

Sacramento, Cal. SAMUEL E. HOLT.

News of the Week

The Mining News given in ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

RAND gold production continues to increase—Copper industry in Wales declining—Airplane to be used in mapping large Rhodesian concessions.

Recent developments in Sierra County, California—Fire destroys Inspiration timber plant—Betty O'Neal pays third dividend this year.

Three dredges operating at Fairbanks, Alaska—Canada aiding prospectors—Howey sale pending—Kirkland Lake anticipates higher recovery from ores.

Tonopah Canadian starts new mill—Duthie ships high-grade ore.

Minas Geraes, Brazil, attempts the manufacture of iron and steel.

All reduction in Federal appropriations not due to action of Budget Director; cuts often arbitrarily made in Departments—Osage oil-lease auction on Sept. 30.

Comstock Silver making regular shipments—Texas investigating potash deposits—Leasers on Tom Reed property increasing production.

Ontario's right to build railways over Quebec crown lands upheld by London Privy Council—Sale of Butte & London pending.

Electrification of iron mines at Eveleth, Minn., completed.

Tampico to have new dock facilities to expedite ore shipments.

Production of Comstock Mines Over Half Million Dollars in Second Quarter

Reports from the Nevada State Tax Commission show that the Comstock Mines produced $552,866 in bullion during the second quarter of 1926.

The Comstock Merger Mines, Inc., milled 117,580 tons of ore which averaged $4.72 per ton, and produced bullion valued at $508,106. The Flowery Mines Co., operating the old Berry mine in Six Mile Canyon, milled 14,500 tons of ore which averaged $3.087 per ton, and produced bullion valued at $44,760.

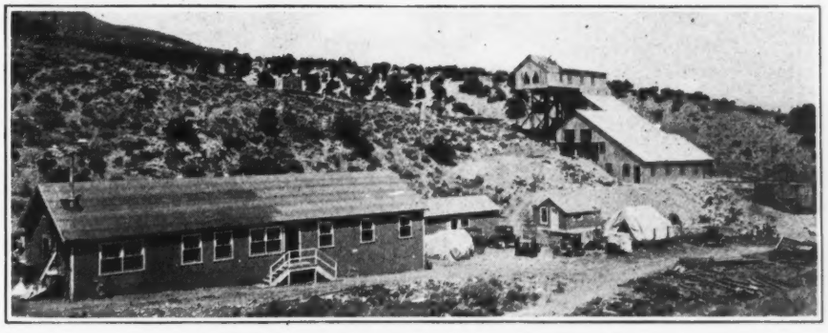
During July the Comstock Merger milled 38,119 tons which averaged $4.75 per ton, and produced bullion valued at $173,746. It is reported that this company has discontinued development work on the 1,200 level from the Overman shaft, the stope fills being too low grade for ore. Development is still under way at the Justice mine.

Carson Files Suit Against Arizona Companies

The Carson Investment Co. filed suits in the Tuscon, Ariz., Federal court last week against the Phelps Dodge Corporation and the Calumet & Arizona Mining Co., charging infringement of patents and processes relating to the charging of smelter furnaces. The cases were set for hearing by Judge Sawtelle for Nov. 16, 1926. The suits ask that the mining companies be enjoined from further profiting by the use of the patents and for an accounting of all past profits.

The defendant corporations in their answer to the complaint charge that Carson obtained the patent illegally and that such letters patent are not valid; that Carson was not the first inventor or user of such apparatus and processes and that the issues raised by the plaintiff are not the same as were used against the American Smelting and Refining Co., from whom Carson obtained a judgment in the court of appeals.

Suits have also been filed by attorneys for Carson in the Federal court at Prescott against the United Verde Copper Co. and the United Verde Extension Mining Co., both of which involve the same issues.



Tonopah Belmont mill at Hamilton, Nev.

Mill at Hamilton, Nev., to Start Soon

The new mill of the Tonopah Belmont Development Co., at Hamilton, Nev., is nearly finished, and it is expected that operations will be started soon. A 9,000-ft. aerial tram from the Cornell No. 2 haulage tunnel will supply the mill with lead-silver ore. Water will be piped from springs near the old California mill. The Belmont company took over the Nevada group and later acquired the Cornell property.

New Mill for Page Mine

Following the development of an ore reserve in the Page mine, formerly the Corrigan, near Kellogg, Idaho, the Federal Mining and Smelting Co., owner, has completed foundations for a flotation mill of 250 tons daily capacity and is erecting the building. The plant is expected to be ready for operation in October.

For more than a year the Federal has been extending development on the 600-ft. level where ore had been exposed. It is said to have established the continuity of the shoot into the Black Hawk, a property adjoining, that is owned by the same company. A compressed air hoist will be supplanted by an electric hoist of greater power. The number of employees is 40 but will be increased to 150 when the property is on a producing basis.

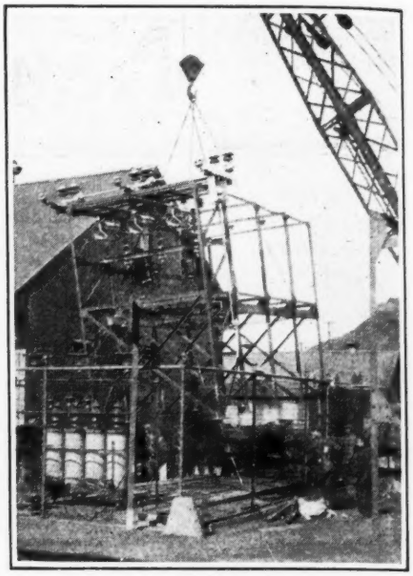
After a suspension of many years, the Page is being restored as a result of the demand for zinc. The former low price for that metal did not warrant its removal and mining for the lead alone was not regarded as profitable.

Spruce-Adams-Leonidas Mines of Oliver Company Electrified

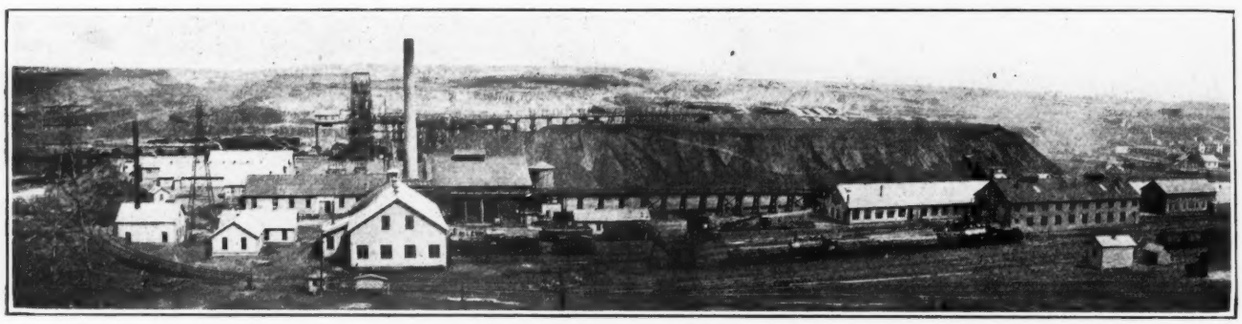
With the completion of a new signal-system installation at the Leonidas shaft of the Oliver Iron Mining Co. at Eveleth, Minn., the change of the Spruce - Adams - Leonidas group of mines from steam to electricity will be completed. This work has been under way for the last two years, and now that it is over and the engine houses finished with varnished hardwood floors, a gray concrete wainscoating five feet high, and the rest of the building whitewashed, the appearance is very pleasing. All pipe and conduit lines are painted distinguishing colors, bright red for conduit and electric runs and black for other lines.

At the Spruce-Adams mine two four-step control electric compressors of 3,000 cu.ft. capacity each, driven by 450 hp. 440-volt motors at 180 r.p.m., furnish the air, and both are busy most of the time, as the sixty gangs employed use "air tuggers" almost exclusively for their slushing operations. The hoists are old steam machines revamped for electric drive by removing the steam cylinders and driving the old drums through herringbone gears. A 400 hp. motor operates the skip hoist and a 200 hp. motor the cage hoist. An air-operated Lily hoist control takes care of the post brakes and eliminates any chance for an overwind by the brakeman.

The Leonidas mine, northwest from the Spruce-Adams, employs approximately 80 gangs of miners and produces close to 1,000,000 tons per year. Its electric equipment is about the same as the Spruce-Adams, except that the shops for locomotive and car repairs are much larger. All the power for this new equipment is supplied by the Minnesota Power and Light Co.



Rapid installation of substation at Spruce-Adams mine



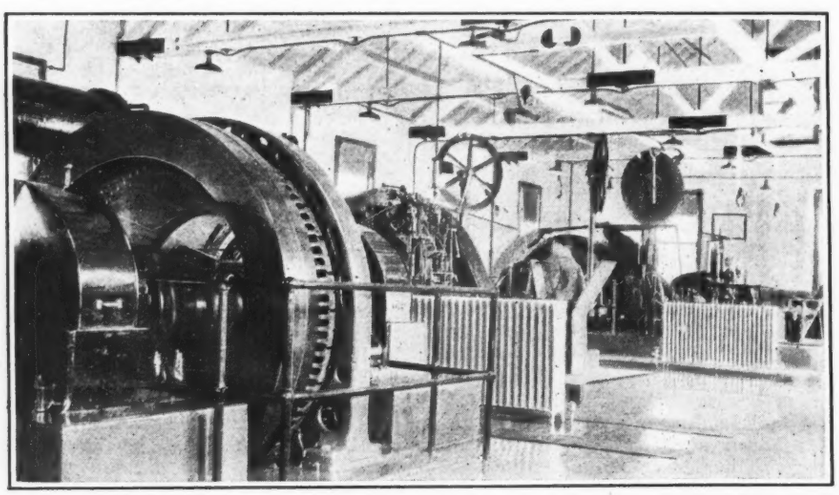
Leonidas mine, showing shaft house, shops, etc., and Spruce-Adams open-pit mine in the distance

Negotiations for Butte & London Pending

It is reported in Butte, that negotiations are in progress whereby Eastern capitalists will take over the properties of the Butte & London Copper Development Co. at Butte, Mont. The property was opened a number of years ago by Thomas F. Cole and associates, a 1,600-ft. shaft having been sunk on the Greendale placer claim, which is owned by the Greendale Exploration Co., of which Butte & London owns 49 per cent of the stock. Silver ore was encountered in the lower workings in a "pink" manganese gangue.

Texas Investigating Potash Deposits

Exploration and ultimate development on an extensive scale of the potash beds that underlie large areas of land in the western part of Texas may result as soon as the necessary arrangements for the proposed operations can be perfected. The fact that beds of potash have been found upon large blocks of land owned by the University of Texas caused the Board of Regents of that institution to send Dr. E. H. Sellards, associate director of the Bureau of Economic Geology, to Europe several months ago for the purpose of investigating various matters connected with potash mining in Germany and France, with the view of determining whether it would be possible to adopt in the proposed operations in Texas the mining methods in use in those countries. Dr. Sellards has just returned and will make a detailed report to the Board of Regents.



Engine house at Leonidas mine, compressor in foreground and hoists at right

Comstock Silver Shipping One Car per Day

The Comstock Silver Mines Co. is shipping a carload of complex silver-lead-zinc ore per day to a Utah smelter from its property at Stockton Hill, Ariz. The mine is 11 miles north of Kingman on the east slope of the Cerbat range. Ore now being shipped is from the dumps of the Prince George group of claims and from stopes above the tunnel on the Banner group. At the latter group one crew is driving a drift from the bottom of a winze below the tunnel level and another crew is driving a drift toward the group from an adjoining property. Two development drifts are being driven in the Prince George workings. F. M. Manson, Kingman, Ariz., operator of the Kingman sampler, is president and general manager of the company.

Mining in Sierra County, Calif., Takes on New Life

The Big Bald Top Gravel mine is being opened and equipped by E. W. Hartman, of Grass Valley, Calif. The mine is in the Scales mining district, which is eight miles northwest of Downieville. The property was originally a part of the McMahon ranch and was hydraulicked in part. Apparently a considerable area of virgin auriferous gravel has been opened up and is being prepared for hydraulicking.

A bedrock tunnel 400 ft. in length was driven beneath the center of the deposit, from which a raise was extended, cutting the gravel at a point 58 ft. above. Bedrock gravel gave good returns. A second tunnel driven across another channel indicated a width of 450 ft., with a thickness of 60 ft. A third channel, 1½ miles long and 300 ft. wide, has been discovered on the property.

Preliminary prospecting was of sufficient promise to warrant the purchase of equipment for hydraulicking and the construction of a ditch three miles long. A road has also been constructed. It is planned to install a steel sluice box, 300 ft. in length, in the bedrock tunnel and to begin operations at the mouth of the raise. Two monitors and 1,500 ft. of steel pipe have been ordered.

The property covers 1,100 acres and was purchased by Hartman from John McMahon, an attorney of Lodi, Calif., who inherited it from his father, Edward McMahon, who located it in 1870.

The old Eureka mine, at Eureka, shut down for forty years, is being reopened, and unwatering is in progress.

The Hartz Gravel Co. has started a 4,800-ft. tunnel to intersect a channel north of Canyon Creek, in the Scales district. Already 1,600 ft. of tunneling has been completed. The Brandy City property, owned by a Los Angeles company under the name of the Pasadena Gold Placer Syndicate, is preparing to construct a ditch system and a log dam for restraining débris preliminary to hydraulicking operations.

H. W. Hartman, of Los Angeles, has purchased the Snowden Hill gravel mine, 10 miles from Comptonville, and is starting operations. He has also purchased the American Flag property, 3½ miles from Comptonville, and is making preparations to install a mill and mining plant. The lode has been partially developed by four tunnels, and sufficient ore is said to be in sight to warrant mining and milling operations.

Fire Destroys Inspiration Timber Plant

Fire starting shortly after 4:30 p.m., Aug. 23 completely destroyed the saw mill and framing shed of the Inspiration Consolidated Copper Co. located at the Live Oak tunnel. The loss in building, materials and machinery is estimated at $25,000. The origin of the fire is unknown.

Realizing that the building and its contents were doomed, efforts were confined to preventing the spread of the flames to the nearby machine shop, blacksmith shop, warehouse, and large stocks of mine timber in the yards. In this they were successful, and the fire was brought under control after an hour's fight.

Chloride Mill Ready Oct. 1

The Chloride Mining Co., Chloride, Ariz., expects to have its new selective flotation mill in operation by Oct. 1. The concrete foundation work has been completed and the rod mill, filters, flotation cells, water tanks, and settling tank are in place. The inclosing structure is still to be built and the machinery is not yet connected. On account of scarcity of water, the tailings will be run through a settling tank, to save some of the water. This commodity is being pumped to the plant through pipe lines from the Payroll and Dardanelles shafts, a distance of 1½ miles.

The mill will be operated as a custom plant, but most of the ore treated will come from the Hidden Treasure mine, which is also owned by the Chloride Mining Co. This mine is said to have plenty of $20 ore in sight, and is counted on to furnish the mill with 150 tons daily. The mine and mill are a mile apart and a tramway is being built to connect the two. Electric power for both is furnished by the Desert Power & Water Co. About 300 hp. are required.

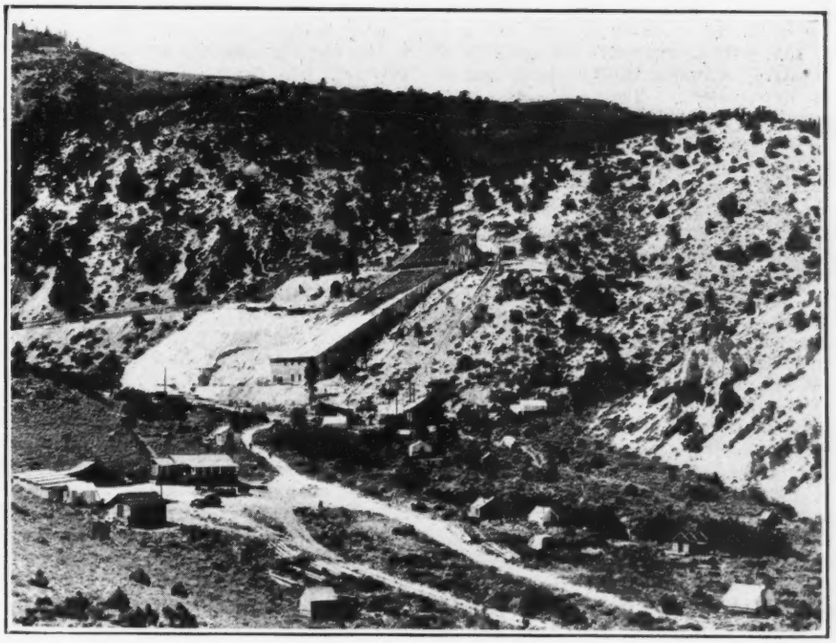
Consolidated Cortez Milled 4,250 Tons in July

The Consolidated Cortez Silver Mines Co., Reno, Nev., operating at Cortez, near Beowawe, Nev., milled 4,250 tons of ore in July. This is the largest monthly tonnage ever handled by the company, and the increase was made possible through changes in the method of crushing. No figures on bullion production or profits are available. The ore in the Cortez mine is generally low grade, but there are occasional shoots of very high-grade silver ore.

Montcalm Claims Under Purchase Option

The Montcalm group of claims in the Rice Lake district of Manitoba has been taken over under option by a group of Toronto and New York capitalists. The ultimate purchase price is $325,000. Although known as the Montcalm claims, the group includes, in addition to the Montcalm claim, the Tine, the Tine No. 1, the Noble, and Noble No. 1 claims.

A crew of twelve men will go into the property immediately, and between $15,000 and $25,000 will be spent within the next two months in sampling.



View of Silveretta mill under construction. Now completed

Mono Completes Silveretta Mill

The Mono Mining & Milling Co., Sweetwater, Nev., has recently completed its mill at Silveretta Mine, Mono County, Calif. Airplane service is maintained between the office and mine, and between the office and Reno, Nev. C. T. Eastman is general manager.

Leasers Active on Tom Reed Property

The Shank-Schmidt lease on the Tom Reed property, at Oatman, Ariz., produced 650 tons of high-grade milling ore during July. Production for August should reach 1,000 tons, as the operators have recently started working the lease on two shifts. All of this ore is being hauled to the Tom Reed mill by truck. Other leasers on the Tom Reed property sending ore to the mill are Penny-McCullough, at the Grey Eagle shaft, the Lopez-Murrilo, east of the Ben Harrison, and the Shank lease, on the Big Jim property. Mr. Shank, in addition to being heavily interested in the Aztec and Big Jim leases, is one of the principal stockholders of the Stemwinder Mining Co., which is overhauling and remodeling the 100-ton Goldroad mill in preparation for placing that property on a producing basis.

News From Washington

By PAUL WOOTON
Special Correspondent

Budget Director Not Always to Blame for Reduced Appropriations—Cripple Creek Mine Gases Being Studied

BLAME for the failure of proposed appropriations frequently is laid at the door of the Director of the Budget, when that official is in no way responsible. When the head of a bureau is convinced that additional funds are needed to carry forward work which is in the public interest he submits a tentative estimate to the Secretary of his department. The estimate, however, goes to the assistant secretary, who serves as the budget officer. The secretary himself usually does not have the time to give personal attention to the details of these estimates. Frequently the assistant secretary reduces estimates drastically without taking the trouble to learn the extent of the need for the proposed work. The Budget Bureau has no knowledge of the cutting which has been done before the figures reach it.

When the estimates finally are laid before the Budget officials it usually happens that further reductions are ordered. After the estimates of all the departments have been submitted to the Budget Bureau the total invariably exceeds the amount which the President is willing to request of Congress. Before the departments submit their estimates the Director of the Budget makes a systematic calculation as to the total expenditure which is justified by the national income. This is laid before the President who specifies an amount beyond which the total of the estimates must not pass.

In order to bring the estimates within the total fixed by the President the various government agencies are called upon to make reductions by the necessary percentages to bring the contemplated outgo within the contemplated income. In such a situation the departmental budget officer does not, in all cases, prorate to each bureau an equitable proportion of the cut. He may take a large portion of the total from two or three bureaus and allow favored activities to contribute little or nothing to the cut.

In this way some of the most urgently needed work frequently is curtailed or eliminated and the Director of the Budget is blamed.

One of the worst features of this practice is that the amount requested for highly essential purposes is kept purposely low in the expectation that the demand for the appropriation will be such as to cause Congress to override the Budget on such items and thus increase the total of the departments appropriations, while the official responsible for the inadequate estimate hides behind the Bureau of the Budget, whose director has no authority to increase the amounts of individual items.

The evils which are growing up under the practice are such that the appropriations committees may require that tentative estimates and the allocation of reductions be made public, so that the departments and independent agencies may shoulder their part of the responsibility.

This matter is of particular interest to the mining industry just at this time, when it has been led to believe that large increases have been asked in an effort to establish those economic services which the industry feels the government should maintain and to increase safety and research work.

Cripple Creek Gases Subject of Bureau Study

E. H. Denny, of the Bureau of Mines staff, is studying rock gas in mines near Cripple Creek, Colo. He is using a special pressure gage on drill holes from which the gas flows. In some of the metal mines at Cripple Creek the inflow or irrespirible gases has affected mining adversely. Lives have been lost and mining operations hindered.

The occurrence of this gas has been studied previously by the Bureau, which is now engaged in a further investigation to determine the extent, character and quality of the gas in an attempt to develop effective and commercially feasible methods of dealing with it. Data are being obtained on the probable chemical origin and on the occurrence and the composition of the gas.

Barometric and thermometric observations will be made over a period of several months to obtain data on the possible effect of weather conditions. The records of volume of flow and pressure will be studied in connection with the observations on temperature and humidity, both surface and underground, and the direction and velocity of the prevailing wind.

Ventilation Problems

F. C. Gregory, of the Bureau of Mines Engineering Staff, is much impressed with the new solenoid control, air operated ventilation doors recently installed in the Ironton mine of the McKinney Steel Co., at Bessemer, Mich. The Bureau is engaged in a study of ventilation conditions in a metal mine and it is recognized that the effectiveness of ventilation depends to a considerable extent on the efficiency of the doors. In some of the mines small auxiliary fans and tubing to ventilate the warmer places are being used. The Bureau is taking temperature and humidity readings at these places and is having air samples analyzed to determine the effect of these devices in improving conditions at the working faces.

Osage Oil Leases at Auction

Oil leases on 30,000 acres of Osage Indian lands in Oklahoma will be sold at public auction on Sept. 30, 1926, at Pawhuska, Okla., in accordance with the terms of an Act of Congress which requires the Interior Department to offer leases for sale on approximately 100,000 acres of Osage lands annually. Regulations covering the sale provide that the leases shall be sold separately in 160-acre tracts to the highest bidder.

Landslide at Burma Mines Kills Twenty

According to a United Press dispatch from Rangoon, twenty bodies have been recovered from the débris at the Bawdwin mine in Burma, due to a landslide. Twenty-four persons were injured and seventy dwellings occupied by laborers were destroyed.

Proposal to Merge Four Mogollon Properties

Negotiations are pending having for their ultimate purpose the consolidation of four of the largest mining companies at Mogollon, Catron County, N. Mex., into a single group. It is reported the plan is being worked out by R. R. Demeter, who has had the matter under consideration for a year or more. It has met with the approval of the owners of the companies concerned in the consolidation, and if the legal details can be agreed upon the plan should become a reality in the next few months.

The companies concerned in the proposed merger are the Mogollon Mines Co.; the American Silver Corporation, formerly the Socorro Mining & Milling Co., now in the hands of a receiver; the Whitewater Power & Mining Co., of which R. R. Demeter is the representative, and the Alberta Development Co.

Goldsmith Mine Repairs Fire Damage

All the damage done by fire to the surface plant of the Goldsmith mine, of the Crystal Copper Co., Butte, Mont., has now been repaired and active mining operations and leasing soon will be resumed, according to P. A. Brady, manager, who recently returned to Butte after making an inspection of the Premier Paymaster mine and mill at South Porcupine, Ontario.

Moore Mine Cuts Faulted Oreshoot

A crosscut on the 1,800 level of the Moore mine, near Jackson, Calif., cut the faulted oreshoot mined in upper levels at a distance 170 ft. northeast of the station. The vein is 18 ft. in width and carries gold in varying amount. Drifts have been extended in both directions to an aggregate length of 150 ft., where the vein was cut off by faults at both ends. The original average assay value was not maintained. Drifting is being continued under the northerly fault with the object of picking up the continuation of the vein. A raise is being put up near the crosscut to connect with the upper level and to explore the oreshoot. Milling operations have been resumed, as has work in the 1,100 and 1,200 stopes. An additional assessment has been levied.

International Nickel Buys Swedish Patent

The refinery built by the British-America Nickel Co. at Deschenes, Que., has been purchased in the liquidation of that company by International Nickel Co. in order to acquire a Swedish refining patent that went with it. The International has dismantled the plant, removing the machinery to its Port Colborne refinery, and the buildings are now for sale with provisons against their use for smelting.

Canadian Aid for Prospectors

With the rapid expansion of the mining industry in Canada, the responsibilities of the federal Department of the Interior are assuming large proportions. This one department has direct administration over 2,250,000 square miles of territory, composed of Crown lands in Manitoba, Saskatchewan, Alberta, the Northwest Territory, Yukon Territory, and a portion of British Columbia.

To administer the mining regulations effectively and fully to co-operate with and advise miners and drillers in the development of their leases, the department has established two offices in the West, one at Calgary, Alberta, and another at Estevan, Saskatchewan. The offices are staffed by competent mining engineers, whose advice, assistance, and equipment are always at the service of any legitimate operator. These engineers make careful studies of subsurface geology and record carefully the results of all drilling operations. Records are correlated and underground maps prepared which are available to engineers and organizations interested.

Manufacture of Iron and Steel in Minas Geraes

There are several plants in the State of Minas Geraes, Brazil, as well as a few in São Paulo, according to the U. S. Department of Commerce, where attempts are being made to produce steel. But few of these are of any importance, and only one, the Companhia Siderurgica Belgo-Mineira, is operating with a steady, though small output of steel. Pig iron, however, is produced at various blast furnaces in these two states.

The plant above mentioned is at Sabara, State of Minas Geraes, one of the oldest towns in Brazil, and, like Ouro Preto, became known by reason of its rich gold deposits. The present steel mill is on the site of a former gold-washing establishment, about 400 miles from Rio de Janeiro, with which port it is connected by the Central of Brazil Railway. The altitude of Sabara is 850 meters, and is surrounded by hills rich in iron ore which are not more than 800 ft. higher than the town.

The steel mill at Sabara was begun about five years ago, and its progress has been slow, although it is completed and has been working regularly for some time.

The company's blast furnace has a production of twenty-five tons daily (twenty-four hours), using charcoal and hematite ore, the iron content of which varies between 45 and 50 per cent. This ore comes from the immediate neighborhood and is siliceous. The limestone used is also found near the establishment. The same holds true for the charcoal used. On an average from 850 to 900 kilos of charcoal is required to produce a ton of pig iron. The pig iron produced contains graphite and is free from sulphur and phosphorous. The slag is granulated and serves in the manufacture of blast furnace cement. A second blast furnace is under construction and is now about 75 per cent completed.

Baldwin Gold Reorganized

The reorganization of the Baldwin Gold Mining Co., Ltd., of Kirkland Lake, Ont., has been completed. A new company has been formed under the title of Baldwin-Kirkland Gold Mines, Ltd., with a capital of $5,000,000, in one dollar shares. The shareholders of the old company have received 2,499,990 shares. The new company has sold 500,000 shares from the treasury and has agreed to give the purchaser an option on the balance of 2,000,000 shares in their treasury, which, if taken up, will give the new company a total of $400,000 in cash. The new company is now doing development work on the property with a force of 20 men, in charge of T. Trevaille-Williams.

Hoist Being Installed on C. & H. C. 81st Level

At Calumet & Hecla Consolidated, Calumet, Mich., a power line is being constructed in the 81st level haulage tunnel from the Red Jacket shaft to No. 7 shaft, Hecla branch, to supply power for the electric hoist which will serve No. 7 at the 81st. Installation of this hoist and the one at the 78th level of No. 4 shaft, Calumet branch, is proceeding.

A shaft house, 40 by 40 ft. is being built at No. 3, North Tamarack, at Calumet, Mich. This shaft will be reopened by Calumet & Hecla Consolidated to connect with Tamarack Junior ground which is being worked by drifts from the slope shaft of the Red Jacket branch. No mining will be done in No. 3, which is bottomed at a vertical depth of 5,223 ft. from the surface, below which is an incline shaft, 767 ft. Rock of unusual richness is coming from stopes in the Tamarack Junior tract.

Portland Canal Short Line May Be Reconditioned

E. O. Weston, acting for Vancouver and New York interests, has made an examination of the old Portland Canal Short Line Ry., and has canvassed property owners along the line to discover how much freight could be guaranteed. He states that his principals are prepared to recondition the line and put it into operation if sufficient patronage can be assured. The Portland Canal Short Line was built by MacKenzie & Mann in 1911, but it was abandoned two years later. It runs from Stewart for 16 miles up the Bear River valley, along which a number of important mining properties, including the Dunwell mine, are situated.

Efforts to Increase Recovery From Kirkland Lake Ores

Companies operating in the Kirkland Lake area of Ontario are endeavoring to find a means of preventing loss of gold in tailings, which is stated to average about 10 per cent. The ore is so subject to sudden change that consistent favorable recovery has not yet been established. There has, however, been a substantial improvement during the last year, and a further betterment is anticipated, but as some of the ore is free milling, whereas in other places there are deposits of heavy tellurides, it is not believed the general recovery can reach more than 90 per cent.

Sale of Interest in Howey Pending

Negotiations for the sale of an interest in the Howey property in the Red Lake area, Ontario, to Percy A. Robbins, former general manager of the Hollinger Consolidated, are in progress. It is stated that the decision of Dome Mines Co. to withdraw was more on account of the severity of the terms of the option rather than for any other cause.

Loring Increases Arizona Holdings

The Zonia property, consisting of fourteen patented claims in the Walnut Grove mining district, 20 miles south of Prescott, Ariz., has been purchased by W. J. Loring and associates from James L. Gillingham, of New York. The property in this district owned or controlled by Mr. Loring and his associates now totals about a hundred claims. There are twenty men at work on the Zonia property. The Mayflower and Copperopolis shafts are being cleaned and repaired. At the former shaft a hoist is being installed, and at the latter a portable compressor has been set up to facilitate dewatering.

High-Grade Ore Reported by Montana-Idaho

S. P. Burr, superintendent of the East Pacific operations of the Montana-Idaho Copper Co., Delage, Idaho, confirms the rumor that shipping ore has been encountered in the old workings, this new ore assaying 38 per cent lead, 6 per cent zinc, and 47 oz. silver. The East Pacific group is situated 6 miles from Winston, Mont.

Three Dredges Operating at Fairbanks, Alaska

The 5-cu.ft. Yuba dredge installed on Fish Creek, in the Fairbanks district, Alaska, began digging in July, and everything is progressing in good order. This dredge is operated by the Tanana Valley Gold Dredging Co., financed by English capital. There are now three dredges operating in the Fairbanks district. A fourth dredge is being installed by the Nome Creek Dredging Co. on Nome creek near Fairbanks. The American Creek Dredging Co., with headquarters in Fairbanks, is making plans for the installation of a gold dredge in the Hot Springs district.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Ontario's Right to Build Railway Over Quebec Crown Lands Upheld

It is understood that as soon as the Dominion situation at Ottawa clears up, which will be after the Dominion elections on Sept. 14, Premier Ferguson of Ontario will apply for an order to permit the extension of the Nipissing Central Ry. into the Rouyn district of Quebec. Following the judgment by the Privy Council in England, acknowledging the right of Ontario to build over Quebec Crown lands, the Ottawa Government was unable to deal with the application of Ontario until the receipt of the formal judgment from England. By the time this had arrived the Government in power had been defeated and arrangements were being made for a new election. It is believed that the extension of this line is important for the development of Quebec, as it would run in an east-west direction along the strike of the great gold belt which runs through from Kirkland to Rouyn. While there has been a great deal of opposition by the Quebec Government to the construction of this line, its ultimate effect would be beneficial to the latter province as it would connect the mining districts of Quebec with those of Ontario and open up a large field for equipment and labor.

The results on the properties in Montbray Township which the Nipissing Mining Co. of Cobalt, has under option are stated to be encouraging. A number of diamond drill holes have been put down and indicate a sulphide body carrying copper and gold, but no announcement has been made regarding values. Some of the holes have cut ore of satisfactory grade.

The Plata silver mine, a subsidiary of the Noranda, and the W.J.9, a subsidiary of the Huronian Belt Co., are both sinking shafts, which will have to go to a depth of 500 or 600 ft.

At the Coleroy the shaft is being continued another 150 ft., which will bring it to about 600 ft. Some commercial ore was found at the 400-ft. level, but it is believed that this was too close to the contact. Practically all of the ore in the Gowganda district is found in the diabase below the Keewatin and as a general rule this requires considerable depth to reach the favorable horizon.

Gowganda, a Promising District

Conditions throughout the Gowganda district are satisfactory and the camp is really just coming into its own, although it was discovered about eighteen years ago. Production is showing a substantial increase and it is probable that other new mines will be discovered.

The Castle-Trethewey mine, Gowganda, has decided to continue the No. 1 shaft to a total depth of approximately 600 ft. This shaft was sunk 300 ft. some years ago, at a time when the geology of the Gowganda district was not understood as well as it is now. The estimated expenditure for this work is approximately $100,000. In addition to this the company is putting up a number of dwellings and is installing a water works system. The mill is treating over 100 tons a day and in view of the largely increased development program, it is expected that the output will also be increased.

At the Miller Lake O'Brien, which adjoins the Castle, additions to the mill are practically completed and the plant is expected to resume operations within a few days. It has been closed down for some months during its reconstruction which will increase the capacity from 60 to about 100 tons a day.

Tonopah Canadian Starts New Mill

The new mill of the Tonopah Canadian Mines Co., Gowganda, started operation on Sept. 1. This mill, which has a capacity of 125 tons a day, embodies all the latest improvements and will probably be one of the most efficient and economical mills operating in the silver camps. Developments at both the Walsh and the Morrison properties have been extremely satisfactory. The Walsh is a high-grade property and it would not be surprising if it is found, when the mill is in operation, that the Tonopah has the highest mill heads of any mine in the province. At the Morrison the ore is of lower grade, but can probably be mined over substantially greater widths than at the Walsh. During the past eleven months, a total of 4,000 ft. of drifting and crosscutting and two 75-ft. winzes have been accomplished at the Morrison with one machine operating on two shifts.

Kirkland Lake Benefited By Reduced Power Rates

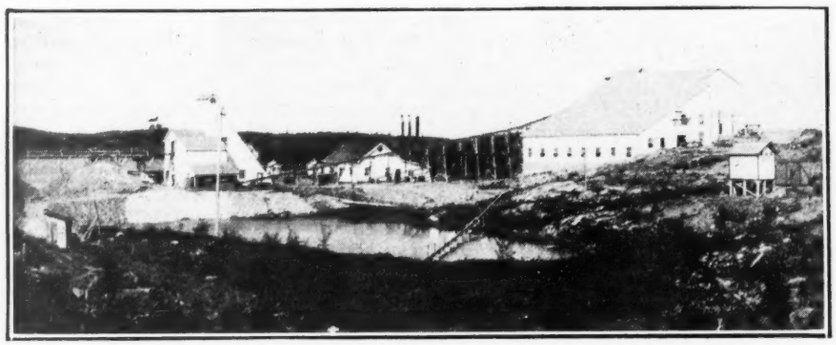
The expansion of mining activity at Kirkland Lake, Ontario, will be greatly promoted by a complete readjustment of electric power rates and conditions. It is officially announced that in addition to a modification of the rate a more abundant supply of power will be furnished to the mining companies. Owing to the uncertainty of being able to secure adequate supplies of power, companies have been obliged to approach with caution the question of enlarging the capacity of mining plants and mills. With the assurance of ample supplies of power, expansion on a large scale is anticipated.

Duthie Shipping High-Grade Ore

The Duthie mine, Smithers, B. C., owned by J. F. Duthie, of Seattle, continues a steady shipper of high-grade, hand-sorted ore to the Trail smelter. The ore now being shipped is the highest grade that this mine has yet produced and as it is from the lowest level so far reached the indications are most encouraging. It carries not only galena, which has been the main product of the mine so far, but also much ruby silver and gray copper. Production is between 200 and 300 tons per month.

Richfield Mine Promising

The Richfield mine, at Topley, B. C., discovered by Frank Taylor on June 7 of this year, continues to prove itself even better than at first reported. The ore has good values in gold and silver. Mr. Taylor has been driving a tunnel to crosscut the surface showing at a depth of about 50 ft. The tunnel shows solid ore and is below the region of oxidation.



New mill and shaft house, Tonopah Canadian Mines Co., Gowganda, Ont.

Explosion at Dome Mines Kills Three Men

As a result of an explosion at the Dome Mines, Porcupine, Ont., which occurred Aug. 26, three men are dead and one blinded. It is believed that the accident was caused by the premature explosion of three cut holes on the 1,600-ft. level of the mine.

Mohawk Vein No. 6 Widens

At the Mohawk copper mine, Mohawk, Mich., the vein in No. 6 shaft not only is widening at depth but is showing unusual values. It is rich with heavy copper. No. 6 shaft, the richest unit, has 1,600 ft. more to sink before reaching the boundary. In addition to No. 6, a large amount of ground remains in No. 4. Each of the four stamps is equipped with regrinding unit.

Arcadian to Resume Development

Arcadian Consolidated, near Hancock, Mich., expects to resume development work in its new Baltic shaft about Nov. 1. It will be necessary to pump out the shaft to the 9th level, where drifting will proceed to the south. Work has been stopped at the new Arcadian shaft and removal of the surface plant to the new Baltic is under way.

London Letter

By W. A. Doman

Special Correspondent

Rhodesian Congo to Be Mapped by Airplane—Lena Goldfields Profits Uncertain

London, Aug. 18—An interesting statement has been made concerning the Rhodesian Congo Border Concession. The company has rights embracing 52,000 square miles, and to survey this thoroughly would naturally require a very long time. The concession was acquired in the belief that valuable copper deposits would be discovered. Not only have indications of the metal been reported, but the area lies between the Katanga belt in the north and proved areas to the south and east. The prevailing belief is that an immense bed exists, stretching from the Belgian Congo mines worked by the Union Minière to Kafue, where the metal is being won. As the Rhodesian Congo Border Concession is largely covered by bush, the managers of Minerals Separation, Ltd., have adopted the novel idea of survey by air. The Aircraft Operating Co. will dispatch an expedition to carry out preliminary mapping over a territory of 20,000 square miles. The photographs will be examined by geologists, who, it is expected, will be able to form an accurate estimate of the character of the ground. The airplane has been requisitioned elsewhere to carry stores and materials to a mining district, but the Minerals Separation venture is the first occasion on which it is to be used in Africa for mining-survey work.

The report on the Indian Currency Commission has not benefited the shares of silver-producing companies. All of them are lower, as it can be shown that a 1d. per ounce makes a difference in the profits as compared with those of last year equal to 3 or 4 per cent. Some authorities, however, express the opinion that silver will still be absorbed, both by India and China, and that the selling movement has been overdone. Burma Corporation and Santa Gertrudis have suffered to the greatest extent, though some of the Australian Broken Hill stocks have been on offer. Dealers, when asked why silver shares have dropped, merely remark "Mexico." This does not seem to connect the selling movement with the Indian Currency Commission report.

A kind of platonic interest is being awakened in the doings of the Lena Goldfields. Some parcels of the gold won are being transported from Moscow to London by airplane, for the metal to be refined. Whether the Soviet authorities or the company are responsible for this advertising is not clear. Everyone knows that the Lena Concession is remarkably rich and that gold is being won. What holders of Lena shares want to know is: What proportion of the gold produced will accrue to them, and when? The expenditure that must be made upon the concession, and the percentage payable to the Soviet Government, seem to put dividends very much in the background, not to mention that the company has to sell the gold to the Soviet Government in depreciated chervontsi. The 8 per cent notes issued some months ago at 80 are quoted today at about 65 per cent, and very often price represents credit or confidence.

Mining engineers have to weigh their words very carefully, or some person or other is fairly certain to misuse them. Mr. Homersham, who has examined the Central West Gold (Rand), expressed a certain opinion recently, which has been seized upon by holders of a block of shares and used to attempt to boost the price. At the moment it cannot be said that the shares are worth more than the quoted figure of about 3s. 6d., as production has ceased and the property is being further tested.

Tin shares, I am told, are to be taken in hand again at the end of the present month.

Copper Industry of Wales Declining

The copper industry of Swansea, Wales, established over 200 years ago, and which has been slowly declining in face of foreign competition during the past twenty-five years, is now carried on by only two concerns, according to the U. S. Department of Commerce. One of these, the British Copper Manufacturers, Ltd., an amalgamation of three other works, is making drastic efforts to keep afloat. During the last two years it has made extensive changes in its working program, reduced employees and staff by some 50 per cent, and installed the latest refining plant. Considerable local interest has been aroused by this company's effort to save for Swansea the industry which, nearly two centuries ago, first attracted metal working to this district. The other plant—the Rio Tinto Copper Co., which has its own Spanish mines—is working intermittently. This concern's resources are also very large. Time, however, will show whether these two firms will weather the growing competition that has closed most of Swansea's old-established plants.

Improved Facilities at Tampico to Expedite Zinc Shipments

It is expected that the zinc-mining industry of Mexico will be given a great impetus by the reduction in the handling charges at the port of Tampico which will be brought about as soon as new dock facilities there are provided. The National Railways of Mexico has leased one its wharfs to the Empresa de Maniobras Maritimas, and it is to be immediately equipped for the exclusive handling of zinc concentrates and raw zinc ore. Elevators of the belt conveyor type will be installed for the economical handling of minerals. The National Railways will construct additional storage tracks at the wharf at a cost of $100,000, United States money. It is estimated that the new method will enable the loading of a 6,000-ton cargo of zinc concentrates in two days, as compared with six days as at present. Demurrage charges on cars will also be saved.

Johannesburg Letter

By John Watson

Special Correspondent

Rand Production Shows Increase for June—Diamonds and Tin Gain

Johannesburg, July 27—The following crushing results, for the month of June, from fourteen leading Rand gold mines, have recently been published. The mines are arranged in order of profits earned:

	Tons Crushed	Value, or Revenue,	Costs, Per Ton s.	d.	Estimated Profit
Government Areas	200,000	£379,409	16	0.7	£220,341
New Modder.	128,000	290,779	18	6.5	172,096
Crown Mines	227,000	293,554	17	10.3	90,828
Modder Deep	44,200	99,750	15	2.0	66,182
Springs	68,200	127,861	19	2.9	62,264
Brakpan	86,500	138,424	18	10.3	56,875
New State Areas	76,000	133,088	20	7.4	55,105
Modder B.	66,500	113,414	18	1.6	53,129
Van Ryn Deep	69,300	105,977	16	3.8	50,481
Geduld	81,000	117,056	17	0.0	48,178
City Deep	98,000	146,107	22	7.9	35,092
Randfontein Estates	205,000	211,576	17	5.9	35,065
West Springs.	48,900	77,029	18	7.7	31,446
Robinson Deep	74,500	.....	18	0.9	30,597

The Transvaal gold output for the month of June was 852,145 oz., having a value of £3,619,682. This is an increase over the May output of 2,968 oz., equal in value to £12,450. These figures establish a new record for monthly output. March, May, and June have each beaten previous records. There was a notable improvement in the output from the smaller mines classed under "Miscellaneous"; also Government Area had an increase of 6,638 oz. over the May returns. The native labor position is satisfactory.

The output of minerals in the Union of South Africa for the first five months of the year, according to the Department of Mines, has been as follows:

January to May (both inclusive)	1926	1925
Gold	£17,151,405	£17 009,974
Silver	54,461	71,345
Osmiridium	41,395	55,981
Diamonds	3,684,096	3,305,042
Coal	1,569,210	1,620,452
Copper	212,321	210,607
Tin	137,414	97,918
Other Minerals	116,249	108,667
Five months' totals	£22,966,551	£22,480,886

The production of crude platinum in May was 1,052.412 oz. (containing 71.31 per cent platinum metals); in April the production was 841.05 oz. (containing 72.63 per cent platinum metals).

On the Johannesburg Stock Exchange, during the last week, the share market has been active and London business has been a marked feature. London bought Sub-Nigels and Modder B; but has been selling leading gold dividend-paying shares. These selling orders are attributed to Paris sales in London. Sub-Nigels have again been largely dealt in; but the price during the week has receded from 56s. 9d. to 55s. 3d. T. C. Lands have been quiet, and their price has fallen from 54s. 6d. to 53s. 6d. Potgietersrust platinums have remained steady at about 9s. 9d. Transvaal platinums have dropped from 15s. to 9s. 6d. during the week. Onverwachts have remained at about 19s. 6d.

People You Should Know About

E. A. Julian, manager for the Wingfield mining interests, has been in Reno, Nev., from his San Francisco headquarters.

Sir Alfred Mond, chairman of the Mond Nickel Co., has sailed from England for Canada, where he will spend several weeks.

W. S. Burbank, of the Geologic Branch of the Geological Survey, has been appointed assistant geologist and will work with **B. S. Butler** in Colorado.

Charles Chaffin, eastern manager for the General Engineering Co., has returned to New York after several months spent visiting various mining districts in the West.

E. O. Ulrich, of the Geologic Branch of the U. S. Geological Survey, recently left Washington, D. C., for northern Michigan to advise with the state geologist on certain problems.

W. E. Simpson has been retained as consulting engineer by the Porcupine Kirkland Gold Mines, Ltd., and will superintend diamond-drilling operations on the company's property.

Seigmund Hirsch, one of the largest copper and brass fabricators on the European Continent, is inspecting the plants and mines of the Anaconda Copper Mining Co. in Montana.

Sam Hugh Brockunier is making an investigation of the one-time bonanza silver district near Port Arthur, Ontario, in which the Beaver and Rabbit Mountain mines are situated.

Fred Searls, Jr., formerly with the U. S. Smelting, Refining & Mining Co., is attending to professional business in Butte. Mr. Searls is now consulting engineer with the Newmont Mining Co.

J. F. Alcock, of the Canadian Department of Mines, has been investigating the extent of the lead and zinc deposits contiguous to the Grand Trunk Pacific section of the Canadian National Railway, for his department.

A. P. Anderson, consulting mining engineer for the U. S. Smelting, Refining & Mining Co., is at Fairbanks, Alaska, in connection with the operation of the Fairbanks Exploration Co., a subsidiary of the U. S. Smelting Co.

George W. Danehy, mining engineer, formerly metallurgist for the Tonopah Belmont Development Co., at Tonopah, Nev., has recently been appointed mine engineer for the company's McNeill mine, near Wickenburg, Ariz.

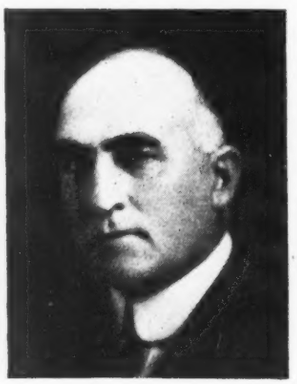
Kilian E. Bensusan, an engineer of London and Brazil, who has been engaged in geological work with a field staff of the British Controlled Oilfields, Ltd., in Venezuela, is in New York. His address is care of Kirby Thomas, 25 Broadway.

John L. Dynan, for the last ten years mine superintendent for the Tonopah Extension Mining Co. at Tonopah, Nev., has resigned and will remove to his former home in Bethlehem, Pa. He is succeeded by **William O. Vanderburg,** formerly mining engineer for the same company.

C. W. Adams has resigned from the position of manager of the Selby plant of the American Smelting & Refining Co. near San Francisco. Mr. Adams had been connected with the company for a number of years, and left the position of manager of the East Helena plant to direct operations at the Selby plant about a year ago.

H. G. Hymer, engineer and geologist at the Verde Central mine, at Jerome, Ariz., has taken an eighteen months' leave of absence and left for South Africa, where he is to do some geological work for the North Rhodesia Concessions, Ltd., an English syndicate which controls large areas in the territory south of the Katanga district.

Albert Burch, mining engineer of Medford, Ore., has returned to San Francisco from a mine examination near Tucson, Ariz., and is now on his way to Butte, Mont.



Albert Burch

Johannes Walther, a distinguished German geologist, has been appointed James Speyer visiting professor at Johns Hopkins University for 1926-27. Professor Walther is president of the German Academy of Science, director of the Halle Mineralogical Institute and Haeckel Professor of Geology and Palenontology at the University of Halle.

Dr. W. A. J. M. van Waterschoot van der Gracht, petroleum geologist and a director of the Marland Oil Co., is in Calgary, where he is organizing a geological party to examine lands of the Hudson's Bay Co. if geological findings warrant. A considerable portion of the Hudson's Bay Co. lands that are thought to contain oil have been leased to the Imperial Oil, Ltd.

E. L. deGolyer, president of the Amerada Corporation, announces the organization of the Geophysical Research Corporation. The company will manufacture a specially adapted seismograph instrument to be used for oil exploration and will engage in surveys under contract with its own personnel or lease its patented instruments where experienced operators are not required.

H. L. Patridge, of Globe, Ariz., has been appointed a special master in chancery to take evidence, examine witnesses, hear and determine the issues of law and fact, and to report his judgment on two important cases, in the suit of the Carson Investment Co., and George Campbell Carson, vs. the United Verde Copper Co., and the United Verde Extension Mining Co., a patent infringement suit.

H. W. Gepp, general manager of the Electrolytic Zinc Co. (Australia) since its organization, has been offered the position of chairman of a migration commission being organized by the Australian Government. The arrangements, however, are not yet completed, as the Prime Minister intends to submit the proposal to Parliament, his hope being that it will receive the support of all parties.

N. A. Timmins, president of the Hollinger Consolidated Gold Mining Co., has joined the board of directors of Canada Northern Power Corporation. Mr. Timmins is deeply interested in the power situation in the mining districts of northern Canada. Hollinger is by long odds the largest consumer of power in the northern field, and its requirements are steadily increasing. Mr. Timmins is also associated with the most prominent of the new developments in the Quebec field, and the amount of power these will take within the next few years is expected to be extensive.

Daniel H. Harrington, of Salt Lake City, Utah, was recently appointed chief engineer of the Safety Service Division of the U. S. Bureau of Mines. Mr. Harrington served as a mining engineer of the Bureau of Mines during the period 1910 to 1924. On July 1, 1924, he resigned the position of supervising mining engineer in charge of investigative work in mining west of the Mississippi River, and opened a consulting mining engineer's office in Salt Lake City. During his former connection with the Bureau of Mines, Mr. Harrington made a special study of health problems of workers in metal mines, giving particular attention to dust and ventilation problems. He is the author of a number of publications of the Bureau dealing with accident prevention and mine ventilation problems.

Obituary

George Wilkinson, Chief Inspector of Mines for British Columbia, died at Victoria on Aug. 11. He was fifty-one years old. Mr. Wilkinson came to British Columbia from England, thirty years ago. He started work as a miner with the Western Fuel Corporation, and worked his way up through the several stages until he was appointed superintendent of mines for the company. In 1917 he was appointed Chief Inspector of Mines for British Columbia, and retired three years later to become manager for the Pacific Coast Coal Co., which got into financial difficulties and closed its mines two years later. In 1923, Mr. Wilkinson was reappointed Chief Inspector and held the position at the time of his death.

Recent Technical Publications

Reviews, Abstracts, and References

Pirsson's Petrology Revised

Rocks and Rock Minerals. A manual of the Elements of Petrology without the Use of the Microscope. By Louis V. Pirsson. Second edition, revised by Adolph Knopf. John Wiley & Sons, Inc., New York. Price, $3.50.

The late Professor Pirsson's well-known manual, after eighteen years of highly deserved popularity, now appears in a revised edition by his successor at Yale, Professor Knopf. The style has been smoothed out, improved, and clarified in many places, and most of the typographical errors of the earlier edition have been eliminated. Equally important is the correction of errors due to the use of two-dimensional terms where three dimensions are actually involved.

The indolent habit of viewing structures and processes only in plan or in cross-section has placed an incubus of misleading terminology upon the science of geology which few of us can wholly avoid. To the man who sees a dike only in outcrop, the two visible dimensions become length and breadth. Unfortunately, a few terms of this type have escaped detection in the revision. Thus "margins" of dikes (p. 160) and of enclosed bodies of magma (pp. 175, 176, 185, 186), referring to sides; "narrow" dikes (pp. 186, 256, 257), where thin is meant; and "width" (p. 220) instead of thickness. Such slips, although seemingly trivial, are a real stumbling block to the beginner who has learned that the extension of a dike "in length and breadth is great as compared with its thickness" (p. 130).

The general plan of the book remains unchanged, and in most of the text only slight revisions have been made. The principal changes are found in the classification of the igneous rocks. Thus, the distinction between orthoclase and plagioclase feldspars has been introduced and two columns of orthoclase-plagioclase rocks (monzonites, etc.) have been inserted. Diorite has been transferred from the category of dark-colored ferromagnesian rocks to that of the light-colored feldspathic ones, and a quartz diorite column has been added. This is frankly a partial abandonment of the megascopic basis of classification, "for, in general, we cannot discriminate between the different kinds of feldspars" (p. 200). I heartily agree, however, that it is "a distinction that should always be attempted in the field" (p. 203), and the student should be instructed accordingly; at least he should know the significance of these names.

In the text, granodiorite and quartz monzonite are briefly mentioned as varieties of granite—a subordination that seems wise, in view of the difficulty of distinguishing these rocks from granite without resort to the microscope. For the same reason it would also seem wise to simplify the table by omitting the three new columns and placing the new names in small type under granite, syenite, and diorite.

Felsite porphyry, a term retained prominently in the text, has been eliminated from the table; and rhyolite, trachyte, latite, dacite, and andesite have been inserted. Since the more inclusive term must still be used, it should be included in the classification, with the names of the specific porphyries bracketed under it. It is also unfortunate that the brief descriptions of these porphyries (p. 202) are so far removed from the general description of felsite porphyries (p. 255). A cross-reference would help.

The fine distinction between granite porphyry (p. 248) and porphyritic granite (p. 210) is retained, and the situation is not improved for the beginner by the addition of rhyolite (p. 202). Cross-references, together with the clear statement that these form a gradational series, would help both teacher and student and would not be amiss for the young engineer in the field.

Since it is often impossible to distinguish megascopically between hornblende and pyroxene in the rocks, a welcome change has been made in the classification of diorite and gabbro, which are now put on a quantitative basis—approximately equal amounts of feldspar and ferromagnesian minerals in diorite, dominant ferromagnesian minerals in gabbro. Dolerite, which includes the finer-textured, indistinguishable diorites and gabbros, according to the text, has been restricted to the latter in the table—an unfortunate restriction, in my opinion; at least an unfortunate discordance between table and text.

The old (and, as I supposed, discredited) hypothesis of magmatic corundum in the peridotites is retained (p. 246); furthermore, this occurrence is not mentioned in the enumeration of "valuable minerals" (p. 246).

Flow banding is omitted, as in the old edition, from the structures of igneous rocks (pp. 159-168), where vesicular, amygdaloidal, miarolitic, jointing, and columnar structures are described. Certain lavas and the primary gneisses are described as possessing this banding, and it is illustrated in Plate 22 (p. 271). In one place it is called eutaxitic structure (p. 169), a technical term that seems to be superfluous.

In the sedimentary rocks, oil shales are recognized (p. 343) and also the importance of sandstones as petroleum reservoirs (p. 338). Tillite is a notable addition (p. 346), and laterite and loam are quite properly omitted. The formation of laterite deserves mention, however, in connection with kaolinization.

Among the metamorphic rocks the treatment of the gneisses has been brought up to date in description and in the recognition of gneisses of primary origin; but the fact that primary gneiss in many places possesses a parallel linear structure is not mentioned. In a table (p. 363), "slate" is named as one of the metamorphic products of the fine-grained feldspathic igneous rocks; in the text these products are quite properly described as phyllite. Tabular concentration does not always lend itself to clearness. Thus, in the same table (p. 363), the metamorphic equivalents of the ferromagnesian igneous rocks are set down as "hornblende, talc (etc.) schists and serpentine." Taconite (p. 306) and jaspilite (p. 409) are left in some confusion.

Eighteen years ago geologists were beginning to realize that the old conception of the igneous magma as fused rock was erroneous. The weight of tradition and century-old custom retained the ancient terminology, however, and everybody still said—and thought—"molten magma." It seems highly regrettable that full advantage has not been taken of this new edition to bring the book thoroughly into line with modern thought by the elimination of this outgrown terminology. To be sure, it is still used, through an unfortunate inheritance; but nowadays nobody really believes that magma is melted rock. When the issue was fairly faced, even eighteen years ago, Professor Pirsson said quite clearly that the "molten magma" must be regarded as "a complex solution of some compounds in others" (p. 148), as "strong saturated solutions" (pp. 157, 159), and that solubility, not fusibility, determines the order of crystallization (p. 148) and "seems quite sufficient to explain the different variations of porphyritic texture which occur" (p. 159).

Thus in three places the student is reminded of the true nature of the magma, while in scores of places, throughout the book, the old erroneous idea is emphasized by the constant reiteration of the term "molten." In a few places the magma is even described as "fused," or "in a state of fusion"—terms that are still retained in the new edition. It seems hardly fair to the science to let it appear that no progress has been made in nearly two decades toward a clearer conception of the complex magma solutions. Only a beginning has been made, it is true, and far more remains to be discovered than is now known; but the question of molten magma or magma solution is not believed to be in that category. Is it not high time, therefore, for the science to shed some of its outworn habiliments? The beginner "learns a lot of things that are not so," despite our best efforts, and many of these are exceedingly difficult to unlearn. Why mislead him on nearly every page as to the real nature of the igneous magma?

Many will also take exception to some of the statements concerning the composition of the magma; in fact, it is wholly impossible to accept all of them, for the text flatly contradicts itself. Thus, on p. 140:

"We cannot, of course, subject a molten magma directly to investigation, but this may be essentially done if an

average sample of an igneous rock is subjected to chemical analysis."

This is followed by the statement that magmas are made up of certain conventional "oxides" (silica, alumina, etc.).

"Other oxides, including water, are also present, but in such relatively small amounts that they do not exercise any controlling influence and may be neglected."

In contrast is this statement on p. 148, under "Influence of mineralizers": ". . . magmas contain large quantities of volatile substances, especially water vapor . . . they are of great importance in a number of ways in the formation of igneous rocks . . . minerals, such as hornblende, biotite, orthoclase, quartz . . . for their production more or less of the volatile substances mentioned must be present, especially water vapor."

It is further stated that water enters into the composition of some minerals as hydroxyl; also the various volatile substances lower the "melting point" of the magma and increase its fluidity.

"These substances then . . which exert so important a function in the processes of crystallization and in the formation of igneous rocks, are called *mineralizers*."

Similar emphatic statements are made in the discussion of texture, on p. 151.

Nevertheless, giving due weight to all possible exceptions, the book is, on the whole, an excellent descriptive manual for the engineer and the geologist. Its readability and attractiveness have been greatly improved by the adoption of a larger page (5¼ by 8 inches, instead of 5 by 7¼), which permits the opening up of the text by "leading." The insertion of separate plates has been avoided by the use of smooth unglazed paper, on which the thirty-six halftone plates are clearly printed in the regular forms with the text. The excellent illustrations of the original edition have been retained without change, and the general make-up of the book is in every way attractive. It should find its place in the field equipment of both the geologist and the engineer.

J. VOLNEY LEWIS.

Testing and Estimating Alluvials. By W. E. Thorne. Pp. 52. Published by Mining Publications, Ltd., London, England. Price 5s.

A great deal of practical knowledge is compressed between the covers of this little book. The author has drawn freely from his long experience in placer mining to set down useful data for field work and office calculations. His lists of power drill equipment and hand-drill specifications are especially valuable. Although the book may easily be read in an hour or so, it contains material worth pondering over a considerably longer period. The major divisions of the volume treat of alluvial deposits and how to sample them, the drilling party and its organization, hand-drill specifications, instructions for the hand drill, and further notes on drilling. It would be a fine act if other mining engineers, of equally long and varied experience, would record the result of their observations and practical work. That such a record need not be long and still be highly useful the book under review shows.

F. E. WORMSER.

Topographical Drawing Notes. By G. P. Schubert. Pp. 82. Published by the Michigan College of Mines, Houghton, Mich. Price $1.65.

This is an introductory text to the drawing of topographical maps. It takes the student from the use of his draughting tools through to the lettering on the finished map. Numerous methods of computing traverses and plotting them are outlined. A feature of the book is the inclusion of a copy of the U. S. Geological Survey symbol chart, certainly the finest model for topographic maps and draughtsmanship to be found anywhere.

Illinois Petroleum—Press Bulletin Series No. 3, "Illinois Petroleum," has been issued by the State Geological Survey, Urbana, Ill., and may be had for 10c. The third issue of *Illinois Petroleum* contains: (1) A short discussion of the significance of the relations between the structures of Pennsylvanian rocks and those of older, underlying rocks, in connection with oil prospecting in western Illinois; (2) a paper on the prospects for finding oil in central Pike County; and (3) a summary of current operations in the oil fields of Illnois.

Mexico—An interesting bulletin from Mexico is the June edition of the *Mexican Magazine* (Vol. 2, No. 1). This magazine has completed its first year of life, having succeeded in coming through the year without the omission of any issue. Two pages are devoted to statistics, including those of petroleum production and that of gold, silver, lead, copper, and zinc. Ten pages are devoted to a translation of the text of the Law of Mineral Industries of May 3, 1926. A list of active mines in Mexico takes up the last nine pages of the issue.

Selective Flotation—W. E. Simpson has a 4-page article in the *Canadian Mining Journal* of July 23 (Gardenvale, Que.; price 15c.) on "Selective Flotation of Sulphide Ores." Most of his discussion is confined to the use of sodium cyanide, with especial reference to work done at Timber Butte, at the Sullivan mine, and at the Broken Hill.

Engineering Standards — The yearbook of the American Engineering Standards Committee, 29 West 39th St., New York City, has recently been issued and may be obtained on request. The work accomplished during the year is summarized and the status of current standardization projects is given. Nineteen of these projects have to do with mining.

Limestone Mining—J. R. Thoenen is writing a series of articles for *Rock Products* (Chicago; price 25c.) on limestone mining, the first one, in the June 12 issue, being confined to shrinkage stoping, and the second, in the July 24 issue, on "Mining Limestone in Inclined Strata." Practice at the North Georgia Marble Products Co., Whitestone, Ga., and at the American Zinc Co., Mascot, Tenn., is described.

Smelter Chimney — Constructional details of the new 400-ft. reinforced concrete chimney for the Wedge roaster plant of the Consolidated Mining & Smelting Co., Trail, B. C., are given in *Engineering News-Record* of June 3. It is the tallest of its kind in America.

"No Par Value" Stock—The Policyholders' Service Bureau of the Metropolitan Life Insurance Co., New York, San Francisco, and Ottawa, has issued a booklet of 9 pages on "No-Par-Value Stock," giving information as to the advantages and disadvantages of this type of stock, the states in which it may be issued, and the laws regarding taxes. Mining promoters may be interested. Copies may be obtained on request.

Nickel—Dr. Heinrich Wunsch, Eyhof 17, Essen-Rellinghausen, Germany, sends word that he has just published a paper entitled "Das Nickel in der Weltwirtschaft," which may be obtained for $1.50.

Mexican Mining Law—*The Mexican Magazine*, Apartado 2919, Mexico, D. F., Mexico, has issued an English translation of the Mexican mining law, entitled "The Law of Mineral Industries," May 3, 1926. The law embraces 171 articles and 12 "transitory" articles. The pamphlet may be obtained from the above address for $1, Mexican, or 50c. U. S. currency.

Gold Production—Joseph Kitchin contributes a statistical study of gold production to the July issue of *The Review of Economic Statistics*, published by the Harvard Economic Service, Cambridge, Mass. Gold production in 1925 was valued at £80,000,000, the same as in 1924, of which Transvaal produced 51 per cent, and the British Empire, 70 per cent. Mr. Kitchin's article is of 6 pages, and is entitled "Gold Production: a Survey and Forecast."

Patents

Ferroalloys—No. 1,593,157. July 20, 1926. D. W. Berlin, Stockholm, Sweden, assignor to Aktiebolaget Ferrolegeringar, Stockholm. Chromium or other ferro-alloy ores are mixed with reducing and fixing agents and formed into electrodes which are placed in an electric furnace against molten slag or metal.

Shaking Screen—No. 1,594,854. Aug. 3, 1926. P. S. Savage, Buffalo, N. Y., assignor to Robins Conveying Belt Co. Design for a shaking screen operated by an eccentric.

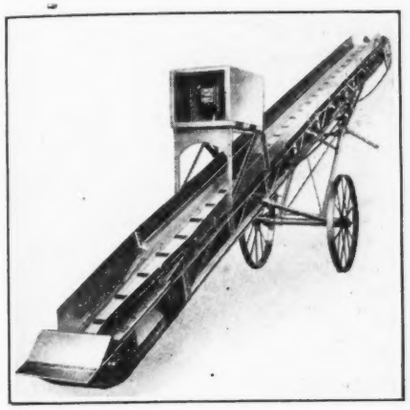
Cobalt-Nickel Separation—No. 1,596,253. Aug. 17, 1926. W. J. Harshaw, Shaker Heights Village, Ohio, assignor to The Harshaw, Fuller & Goodwin Co., Cleveland. In separating copper and nickel, a soluble lead compound present in a solution of the salts of these metals is electrolyzed, lead dioxide being formed which reacts with the cobalt to form cobalt hydrate.

Vanadium Recovery — No. 1,596,483. Aug. 17, 1926. F. F. Frick, Anaconda, Mont. An acid extract of a vanadium-containing material is mixed with the dry residue of a similar solution from a previous operation, and the mixture reduced to dryness.

New Machinery and Inventions

This Conveyor Does Not Shed Material Over Sides

An improved type of portable belt conveyor, designed for handling sand, gravel, coal, crushed stone and other granular materials or small-piece articles, has recently been placed on the market by the Jeffrey Manufacturing Co., of Columbus, Ohio. The purpose of the improvements is to enable material from hopper-bottom railroad cars to be more rapidly handled and to assist in the reclaiming of such materials from piles.



Flared sides increase capacity

The sides of the conveyor trough are curved upward and outward, greatly raising the carrying capacity of the belt. The supporting wheels may be moved forward or backward to balance the conveyor.

Four important improvements included in the design are as follows: (1) Steel side boards bent under the edges of the belt and rising above it on either side form a trough of larger capacity than in like conveyors of earlier design. They prevent lumps from rolling off the belt. (2) An improved type of carrying idler furnishes support to the loaded portion of the belt. (3) An extended and flared loading leg is provided at the bottom of the conveyor, edged with belting material to form a seal with the moving belt. This flared hopper also serves to center the load on the conveyor. (4) An efficient gate at the foot of the conveyor prevents material from falling into the inclosed boot housing.

The new conveyor is built in 18-, 24-, or 30-ft. lengths and may be driven either by gasoline engine or electric motor. With a reliable and easily operated screw the elevator is adjusted to any convenient height. Holes in the pipe struts of the frame allow the wheels to be adjusted forward or backward to balance the load. The foot of the conveyor is low so that it will readily penetrate a pile of loose material. The foot pulley is provided also with aligning screws to bring the belt to center. Steel flights are attached to the 16-in. belt to increase the carrying capacity of the machine. They also keep small round particles from rolling down the belt. They are so arranged that they cannot catch on material and tear the belting.

MacIntosh Flotation Machine Under New Control

All rights to the MacIntosh pneumatic flotation machine have been taken over by the General Engineering Co., of Salt Lake City, Utah, from the inventor J. C. MacIntosh and his associate, William T. MacDonald. This machine was developed by Mr. MacIntosh at the plant of the Moctezuma Copper Co., Nacozari, Sonora, Mexico, and after several months' trial has been adopted for the entire 3,000-ton mill of the company. It is said that this cell has been proved to have the largest capacity per square foot of installation; that it takes less than one-half the power and one-fifth of the cost for upkeep of any flotation machine on the market; and that blinding of the porous medium is practically eliminated. It is said also that in respect to power saving, reduction in operating costs, this new cell offers remarkable economies and metallurgical results.

J. M. Callow is president of the General Engineering Co., and is the inventor of the Callow cell. The company states that it considers that the new flotation machine is the greatest improvement in such machines made since the development of the Callow cell in 1912. Patents have been granted and applied for in the United States and in Mexico, Canada, Peru, Bolivia, and other foreign countries.

New Battery Charging Equipment Announced

As a result of modifications of design, the General Electric Co. is now marketing a complete new line of battery-charging equipments in uniform frame sizes. These equipments consist of motor generators and unit control sections. They are particularly applicable to the multiple charging of batteries used in storage-battery locomotives, electric industrial trucks, and electric road trucks.

The motor generators are designed to operate at speeds running from 1,800 r.p.m., for the sizes up to 35 kw., to 1,200 r.p.m. on larger sizes. Stocks will be carried of outfits for such special voltages at 32, 45, and 55, together with the standard 115-volt type.

Especial attention is said to have been paid to liberality of design. Commutators and brushes have ample capacity for the high currents required with respect to the kilowatt rating.

The generators are flat compounded between no load and three-quarter load, and have slightly drooping characteristics beyond the three-quarter load point. The rise in voltage between these two load points is comparatively small.

A complete new line of unit control sections for these motor generators has been announced. These will be furnished either as part of the complete charging equipment or separately. They are of compact design, so that a large number of circuits may be controlled in a limited space.

The general line consists of two-circuit sections designed for manual control of the charging rate and the terminating of the charge by means of a contact-making ampere-hour meter located on the truck. Such a section includes, for each circuit, a dial switch for the resistor; a meter reading switch; an indicating lamp; a double-pole undercurrent and shunt-trip contactor with two auxiliary circuit contacts; a fuse mounted conveniently on the back of the board; and a resistor, also on the back of the board.

By means of the indicating lamp the operator can tell when the battery is connected to the section. The current is controlled and adjusted by turning the dial switch handle. Amperes and volts are read by the meter-reading switch in connection with a voltmeter and ammeter common to all circuits.

Overcurrent protection is provided by the fuse, and protection against reversal is furnished by the undercurrent contactor. Automatic shut down at the end of the charge is accomplished by the shunt trip device which is an integral part of the under-current circuit breaker, this circuit being energized from the line and completed through an ampere-hour meter mounted on the electric truck or locomotive.

An important feature of the construction is the ease with which a single section with its two resistors may be removed in a unit if necessary. This is accomplished by removing four cap-screws at the corners of the panel and detaching the vertical busbars from the back of the resistor supports. The entire section may then be easily slid out.

Any number of control sections can be combined with generator sections to make a complete panel. Various modified forms of sections are available and will be furnished for any set of circumstances, thus covering every condition of battery charging.

New Use for Belt Conveyor

Recently, at Aurora, Illinois, the Stephens-Adamson Manufacturing Co. celebrated the twenty-fifth year of its activity in the production of labor-saving material-handling machinery by a unique banquet at the Aurora Country Club. The banquet board was equipped with a complete S-A belt conveyor, which extended the entire length. The belt was 18 in. wide, carried on ball-bearing carriers, and operated at a speed of approximately 30 ft. per minute, and was reversible. The various courses of the dinner were served on the conveyor. While this sort of an equipment might never become a commercial possibility, there were those in attendance who expressed the thought that such a labor-saving device would not be beyond the realm of practicability.

Erratum

The section switch described in these pages in the issue of July 24, 1926, is made by the Electric Railway Equipment Co., of Cincinnati, Ohio, and not by the Electric Railway Improvement Co. of Cleveland, as stated.

The Market Report

Metal Prices Firm in Quiet Market

Copper, Zinc, and Tin Show Slight Increases Over Quotations a Week Ago

New York, Sept. 1, 1926—Considering the impending Labor Day holiday, the non-ferrous metal markets have given a very good account of themselves in the week ending today. The cheap lots of copper, which sold a week ago at 14¼c. delivered in the Connecticut valley, were all absorbed in a day or two. Zinc has been firm at 7.40c. in the last two days, and Straits tin, which was close to 65c. most of the week, has been in the neighborhood of 66c. in the last three days. Lead has sold in satisfactory volume at unchanged prices, and the minor metals are also practically unchanged. Silver is slightly weaker, the price yesterday and today being only 62¼c.

Daily Prices of Metals

Aug. Sept.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
26	14 025	63 625	65 375	8 90	8.65	7.375@7.40
27	14.125	63 75	65 75	8 90	8.65	7.40@ 7.45
28	14 15	63.75	65 75	8.90	8.65	7.40@ 7.45
30	14.15	64 125	66.00	8.90	8 65	7.40@7.425
31	14.15	64 00	65 875	8.90	8.65	7 40
1	14.15	64 00	66 25	8.90	8.65	7.40@7.425
Av.	14.125	63.875	65 833	8 900	8.650	7.410

The prices correspond to the following quotations for copper delivered: Aug. 26th, 14.275c.; 27th 14.375c.; 28th, 30th, 31st and Sept. 1, 14.40c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cak[illegible] For ingots an extra of 0.05c. per lb. is charged and there are other extras for shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Aug. Sept.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
26	58½	59¼	66¼	293	288½	32 3/16	31 13/16	34 1/16	34¼
27	59	59¾	66½	293¼	288¾	32 7/8	32 3/8	34 3/8	34 9/16
30	59¼	60	67	294 5/8	290¾	33 1/16	32 9/16	34 7/16	34 9/16
31	59⅜	59⅞	67	295¼	291¾	33⅛	32 9/16	34⅝	34⅝
1	59⅛	59⅞	67	295½	292¼	32⅜	32	34½	34 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug. Sept.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
26	4 84¾	62¾	28⅞	84s11 1/2d	30	4 84⅝	62½	28 13/16	84s11 1/2d
27	4 84⅝	63	29 1/16	84s11½d	31	4 84⅝	62¼	28⅝	84s10½d
28	4 84⅝	62⅜	28 13/16	...	1	4 84¾	62¼	28 11/16	84s11½d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for August, 1926

Copper:	
New York Electrolytic	14.174
London Standard Spot	58.857
London Electrolytic Spot	66.857
Lead:	
New York	8.908
St. Louis	8.722
London Spot	32.756
London Forward	32.345
Silver:	
New York	62.380
London	28.773
Sterling exchange	485.293
Zinc:	
St. Louis	7.376
London Spot	34.173
London Forward	34.524
Tin:	
99 per cent	63.875
Straits	65.260
London	293.690
Quicksilver	89.260
Antimony	15.957
Platinum:	
Refined	116.000
Crude	108.692
Aluminum, 98 per cent	27.000

Monthly average prices, published in the table just above, show healthy increases, compared with July, for copper, lead, tin, platinum, and antimony. Zinc and quicksilver are slightly lower, but both of these metals have recently been firm and there would seem no reason for further declines in the immediate future. Silver prices are weak and the future is uncertain on account of the new Indian currency recommendations.

Copper Sales Improve

Though copper sellers have found the week a quiet one, nevertheless the total sales for the week ending today are somewhat above those of the week before. This is accounted for by the fact that a large tonnage was sold at 14.25 and 14.30c., delivered in the East, last Thursday; in fact, that day's sales alone amounted to more than half of the total tonnage for the week. The cheap offerings were apparently all absorbed for the next day nothing was available under 14.30c., and good business was done at 14.50c. at Middle Western and high freight rate points. Since then, small lots have been sold at 14⅜c. delivered in the East and at 14½c., in the Middle West, with an occasional sale at slight concessions. Yesterday and today it would have been possible for Eastern consumers to obtain copper for 14.35c., or even 14.325c., had they been willing to place an attractive order but they did not seem to show much interest. Apparently, the

only sizeable business of the week was that booked last Thursday, chiefly for the account of a telegraph and a brass company, though a Michigan consumer is said to have placed a good order in his home state in the last day or two.

Producers are not pessimistic over the meager business of the last two weeks, for it was expected, after the heavy sales during July. They expect to do little until after Labor Day. Most of the larger interests have not tried to force the market at all, being well sold up with current production. Consumption seems to be continuing unabated. Most of the copper sold has been for September or October shipment, though a little interest is beginning to be seen in November, and one or two orders for prompt were booked during the week.

Foreign demand has been quiet, with Germany perhaps the chief buyer. American agencies continue to quote 14.65c., c.i.f., but dealers have cut this price 10 or 15 points in some instances.

Lead Still at 8.90c. New York, and 8.65c. St. Louis

Though there has been some expectation that the American Smelting & Refining Co. might reduce its New York price of 8.90c. for lead, the strength in the London market during the last week has prevented much thought of such action. The sudden decline in London prices today is unexplainable as no bearish news has been heard on this side; at that the decline is little if any greater than the sudden advance in London last Friday. Domestic prices are unchanged from last week in both the New York and St. Louis markets. In the East, little interest has been manifested by consumers; prices generally realized have been at the Smelting company's level of 8.90c., effort to get slight premiums not having had much success. In the Middle West, one seller who has quoted on an 8.65c. St. Louis, basis throughout the week has done a good business, in fact somewhat better than last week. There, too, some producers have asked more without getting any response from buyers except in one or two instances. One lot of lead sold in Chicago yesterday for as low as 8.70c., though this price was not general. Most of the lead sold has been for either prompt or September shipment, no interest yet being taken for October. Apparently, there is considerable September lead yet to be bought. Corroding grades continued to command premiums of $2 to $3 per ton.

Galvanizers Buying More Zinc

In the last two or three weeks galvanizers have been taking much more interest in the zinc market and orders from this class of consumers have been much better. They are not only buying in somewhat larger quantities but for later shipment than had been their wont. The volume of sales in the week ending today has not been quite up to that of last week, but has been satisfactory nevertheless, considering the time of year. Prices have advanced slightly, the high level for the week having been reached last Friday when zinc sold as high as 7.475c. for a small car, but this was an outside price. In the last day or two, 7.40c. has generally ruled, though some sellers have done a little business at 7.425c. Brass Special has been neglected lately, though at least one sale was made this week, the price being 7½ points above the level asked for Prime Western. High-grade is somewhat stronger, the 9c. price now being firmly demanded by both sellers, and some sales being reported at that level.

Tin Touches 66⅜c.

The tin market in London has been strong, and prices on this side have gone up as a result. Dealers have made the market fairly active, but there has not been a great deal of consuming demand until today, when prompt deliveries seem to have been especially desired so that the price has gone as high as 66⅜c., though 66¼c. is a fairer average for the day's business. October deliveries have sold for about ⅜c. less than prompt all week. Tin deliveries in the United States amounted to 5,870 long tons in August, compared with 7,630 in July. August arrivals were only 4,685 long tons. A slight decrease in the world's visible supply, estimated at from 500 to 1,000 long tons, is expected for the month just closed.

Little Change in Silver

On Aug. 27, the London market advanced $\frac{3}{16}$d. to 29$\frac{7}{16}$ for ready and 29$\frac{5}{16}$ forward, on acount of buying for China account. Quotations gradually eased off until Aug. 31, when, due to heavy selling by China, the London market declined to 28$\frac{5}{8}$ and 28$\frac{3}{4}$, with the New York quotation at 62¼. The market closes quiet and uncertain.

Mexican dollars (old Mexican pesos) ... 26th, 47⅛c.; 27th, 48⅛c.; 28th, 47⅛c.; 30th 47⅜c.; 31st, 47⅛c.; Sept. 1st, 47⅛c.

Francs Firmer

French francs have been somewhat firmer recently. Closing cable quotations on the principal foreign exchanges, on Tuesday, Aug. 31, were as follows: francs, 2.96c.; lire, 3.29c.; and marks, 23.81c. Canadian dollars, ¼ per cent premium.

Iron and Steel Unchanged

Pittsburgh, Aug. 31, 1926

From July to August there was a slight decrease in engagements in steel, both in strictly new orders and in specifications against contracts. Production and shipments were approximately the same in August as in July, possibly a trifle heavier. The longer range comparison shows July and August to have compared much more favorably with the two or three months preceding than in other years. What is called "seasonal dullness" was small if not entirely absent. The change was due to the hand-to-mouth policy that pervades the distributing and consuming trades, and by the same token an autumn revival or rebound in trade is not to be expected.

With a steel mill operation averaging only slightly below 80 per cent in the last three months, the average in the last four months of the year seems likely to be somewhat less, chiefly on account of decreased movement in such lines as rails, oil country goods,, and building materials as winter approaches.

Steel prices show no quotable change, and little change in strength. Sheets continue slowly to grow firmer, there being now little shading of "regular" prices. Prospects are growing that large contracts for bars, shapes and plates for fourth quarter will be made at prices done on such contracts for third quarter, rather than at advanced prices that have lately ruled on current business.

Pig Iron—The valley market remains dull and there is not much activity elsewhere. Bessemer, $18.50@$19; basic, $17.50; foundry $17.50@$18; f.o.b. Valley furnaces.

Connellsville Coke—Spot furnace coke is firmer, at $3.10@$3.25, but interest in contracts to the end of the year has abated. Spot foundry remains at $4@$4.50.

Zinc and Lead Ore Prices Same as Last Week

Joplin, Mo., Aug. 28, 1926

Blende	Per ton
High	$53.80
Premium Blende, basis 60 per cent zinc	$51.00@$52.00
Prime Western, basis 60 per cent	$50.00
Fines and slimes, basis 60 per cent	$49.00@$46.00
Average settling price, all zinc	$48.34
Galena	
High	$114.45
Basis 80 per cent lead	$112.50
Average settling price, all lead	$111.44

Shipments for the week: Blende, 16,490; lead, 2,649 tons. Value, all ores the week, $1,092,490.

Shipments eight months: Blende, 554,109; calamine, 579; lead, 81,925 tons. Value, all ores eight months, $36,170,970.

Quickly following the removal of individual restrictions upon the output the production was increased to 17,430 tons in one week, but it has not again touched that figure, dropping back to 17,030 last week. This week it was increased but slightly, with additional mills in operation. To lowered efficiency, which usually operates to prevent production exceeding too greatly the demand, alone can be charged the benefit of holding production within a reasonable bound. Purchases each week are taking up the current production and practically all marketable stock has been sold.

Approximately 3,000 tons of lead stocks held last month have been marketed on the current basis of $112.50, along with the weekly production, leaving around 15,000 tons unsold.

Platteville, Wis.

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$52.75
Lead Ore	
Lead, basis 80 per cent lead	$112.50

Shipments for the week: Blende, 1,312 tons; lead, nothing. Shipments for the year: Blende, 36,207; lead, 926 tons. Shipment for the week to separating plants, 2,185 tons blende.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

Aluminum—Per lb., 99 per cent, 27@28c.; 98 per cent, 27c. London, 98 per cent, £118 per long ton.

Antimony—Per lb., duty paid: Chinese brands, 15@15½c. for all positions. Chinese offerings limited but domestic demand is dull. Cookson's "C" grade, spot 18@18¼c.

Chinese needle, lump, 12c. Standard powdered needle, 200 mesh, 13@14c. White oxide, Chinese, 99 per cent Sb_2O_3, 16c.

Bismuth—Per lb., in ton lots, $2.70@$2.75. London, 10s.

Cadmium—Per lb., 60c. London, 1s. 10½d. for American metal; 1s. 9d. for Australian metal.

Cobalt—F.o.b. Canadian works, per lb., shot, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 10s. for metal; 8s. for black oxide; 8s. 10d. for gray.

[1]**Germanium Oxide**—Per gm. in 25 to 50 gm. lots, $6.

Iridium—Per oz., $125@$135 for 98@99 per cent. London, £63@£65 in iridio-platinum; £50@£55 for sponge and powder.

[1]**Lithium**—Per lb., 95@96 per cent grade in 1 to 5 lb. lots, $65.

Magnesium—Per lb., in ton lots, ingot, 75@80c. depending on quality; best 99.8 per cent. Market active. London, 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]**Molybdenum**—Per kg., 99 per cent, $25; C. P. metal, $80.

Monel Metal—Base price for shot, 32c. per pound.

Nickel — Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade). London, £170@£175 per long ton according to quantity.

Osmium—Per oz., $65@$75; London, £17@£20.

Palladium — Per oz., $68@$70. As a constituent of crude platinum, $55@$60 per oz. London, £12@£15, nominal.

Platinum — Official price on refined metal continues at $116 per oz. Open market cash sales of large lots at $111. Pure metal as a constituent of crude platinum, $108.

London, £23¼ per oz. for refined, and £21@£22 for crude and scrap.

Quicksilver—Per 75-lb. flask, $88.50@$91, the lower prices ruling on large lots for forward delivery. London, £15⅝. San Francisco wires $89.67.

Radium—$70 per mg. radium content.

Rhodium—Per. oz., $70@$80; London, £14@£17. Nominal.

Ruthenium—Per oz., $60@$70, nominal. London, £12@£15.

[1]**Selenium** — Black, powdered, amorphous, 99.5 per cent pure, $2 per lb. in ton lots. London reports good demand at 7s. 6d.

Tantalum — Per lb., $36. Nominal only, as only seller has none to offer in open market.

Tellurium—Per lb., $2.

[1]**Thallium Metal**—Ingot, 99 per cent pure, $10 per lb. in 25-lb. lots.

Tungsten Powder—Per lb., 97 to 98 per cent pure, $1.10@$1.15.

[1]**Zirconium Metal**—Per lb., 98 per cent grade, $30 in 5 to 10 lb. lots.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metallic Ores

Chrome Ore—Per net ton, f.o.b. eastern shipping points, $21@$24 for 45 to 50 per cent Cr_2O_3 ore. Prices firm and advance is expected this month. Available supply high-grade chrome ore in U. S. is now lowest in last two years.

Iron Ore—Lake Superior ores, per long ton, lower Lake ports, established season prices:

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

High-phosphorus foundry, over 0.18 per cent P, $4.15.

Eastern ores, cents per unit delivered at furnaces: Foundry and basic, 53 to 63 per cent, 9@10½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit:

Swedish and Norwegian, low-phosphorus, 68 per cent, 10¼@10¾c.

Spanish low-phosphorus, 52@54 per cent 10@11c.

Algerian, low-phosphorus, 9¼@9¾c.

Spanish foundry or basic, 50@54 per cent, 8¾@9¼c.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

Manganese Ore—30@36c. per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn. Caucasian (washed) 53@55 per cent, 40c.

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80 per ton in carloads.

Molybdenum Ore—Per lb. of MoS_2 for 85 per cent MoS_2 concentrates f.o.b. Colorado, 50c.

Tantalum Ore—Foreign, 50c. per lb. of Ta_2O_5 contained, c.i.f. New York, for 65 per cent Ta_2O_5 concentrate.

Tungsten Ore—Per unit of WO_3, N.Y.: Wolframite, $10.50; Western scheelite, $10.75.

Uranium Ore—Minimum 5 per cent U_3O_8 per pound of U_3O_8 contained, $5, f.o.b. Montrose, Colo.

Vanadium Ore—Containing 5 per cent V_2O_5, 25c. per lb. of V_2O_5, f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 55@60c. per pound V_2O_5, duty paid, seaboard. Nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]**Amblygonite**—8@9 per cent lithium oxide, $50@$60 per ton, f.o.b. mines.

Asbestos—F.o.b. *Quebec* mines, tax and bags included, per ton:

Crude No. 1, $525; crude No. 2, $300; spinning fibers, $190; magnesia and compressed sheet fibers, $125@$150; shingle stock, $70; paper stock, $40@$45; cement stock, $25; short fibers, $10@$17.50; floats, $15.

No. 1 Rhodesian crude, $325; No. 2, $250 per ton, c.i.f. New York.

Barytes—F.o.b. mines, per ton, bags extra:

Georgia: Barytes ore, washed, $7.50.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore 93 per cent $BaSO_4$, not to exceed 1 per cent iron, $8, f.o.b. mines. Market very good.

Bauxite—No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3, $8 per long ton, f.o.b. Georgia mines.

Foreign, per metric ton, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

Borax—Carload lots, in bags, per lb.; crystals, 5c.; granulated or powdered, 4¾c; f.o.b. plant, *Pa.*

[1]**Celestite**—90 per cent $SrSO_4$, finely powdered, $27 per ton in carload lots.

Chalk—Crude, in bulk, per ton c.i.f. New York, $4.75@$5.

China Clay (Kaolin)—F.o.b. *Virginia* mines, per ton; crude, lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$20; ground, $7@$10.

Florida, pressed pottery, bulk, $13; dry, sprayed, $17; ground, $20. Fair.

1A grades, domestic, $16@$18, f.o.b. *Delaware* plants. Slow.

Imported English, f.o.b. American ports: Lumps, $15@$25, powdered, 3c. per lb.

Diatomite—Per short ton, f.o.b. plant: Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $30; natural aggregate, ¼ in., $20; air-floated powder, $40. Over 85 per cent silica, 98 per cent through 200 mesh, $14.50@$16 depending on quantity.

Emery — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb. Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

Feldspar — F.o.b. mine or grinding plant:

North Carolina: No. 1 pottery grade, $5.50@$6 per long ton. Market fair.

New Hampshire: Pottery grade, $8 per ton; soap grade, $8.75. Market continues fair.

New York: Per ton, f.o.b. cars, No. 1 crude, $9. Market good.

Tennessee: No. 1 pottery, 140 mesh, $16 per ton; 200 mesh, $18. No. 1 enamel, 140 mesh, $14; 200 mesh, $16. Demand good.

Maine: Pottery grade, $19 per ton. Market good.

Fluorspar—F.o.b. *Kentucky* and *Illinois* mines, per short ton:

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $18. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Market quiet but improving. Foreign competition gradually penetrating farther in from Atlantic coast.

New Mexico: 85-5 gravel, $15.75, 85-5 lump, $16; 93-3 lump, $23; 96-1½, ground 100 mesh, $45.

Fuller's Earth—Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30

to 60 mesh, $18; 60 to 100 mesh, $15; 100 mesh "up," $8; 200 mesh "up," $15. Market fair at unchanged prices.

Powdered, imported, duty paid, $24@$25 per ton.

Garnet — Domestic, per ton f.o.b. mines, $85.

Spanish grades, $60, c.i.f. port of entry.

Gilsonite—Per ton, carload lots, f.o.b. mines *Colorado:*

Jet asphaltum, $36; selects, $33; seconds (mine run), $25.50.

Graphite—F.o.b. New York, per lb.;

Ceylon lump, 7@9c.; chip, 6@8c.; dust, 3@6c. Madagascar flake, 7½@9c. Market quiet.

Flake, 8@30c. according to grade; fine ground crystalline, 4@6c.; amorphous ground graphite, 3c. Crude amorphous graphite, $15@$35 per ton acording to grade. Market very competitive which makes business unprofitable. Plenty of foreign stock coming into the United States and import prices somewhat lower than earlier in the year.

Greensand—Per ton, f.o.b. cars, *New Jersey:* screened and bagged, best grade in carload lots, $30. Trade quiet during summer but should now improve.

Gypsum—Per ton f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$6; agricultural, $6@$11; calcined, $8@$12.

[1]**Ilmenite**—Concentrates, 52 per cent TiO_2, 1½c. per lb., f.o.b. *Virginia* points. $60 per short ton, *Florida* mines.

Iron Oxide (See Ocher)—Standard Spanish red, 3@4c. per lb.; domestic earth, 2@4½c.

Kaolin—See China Clay.

[1]**Lepidolite**—20@$30 per ton for ordinary grades. Nominal.

Limestone — F.o.b. shipping points, depending on location: either lump or crushed, 90c.@$1.80 per ton.

Agricultural, 75c.@$2 for crushed or pulverized. Prices depend upon source, purity, and fineness.

Magnesite—Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $44; grade B, $38; dead burned, $33; crude, $14. F.o.b. eastern seaboard calcined, $40. Market shows improvement.

Mica—F.o.b. plant, per ton:

New Hampshire: Mine run, $360, clean shop scrap, $25@$26; mine scrap, $22. White, dry ground, 20 mesh, $55; $22. White, dry ground, 20 mesh, $30; 40 mesh, $40; 60 mesh, $55; 100 mesh, $70; 200 mesh, $85. Market only fair.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: special grade, $3.35; No. A 1, $2.85; No. 1, $2.50; No. 2, $2.25; No. 3, $1.25; No. 4, 65@70c.; No. 5, 42@45c. Grades depend on size of sheets.

[1]**Monazite**—Minimum 6 per cent ThO_2, $120 per ton.

Ocher—F.o.b. *Georgia* mines, per ton: $22.50@$25 in sacks; $25@$30 in barrels; washed and water floated, $25@$28; second grade, 99 per cent through 225 mesh, $19.

Phosphate—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent $4. Firm.

Florida, pebble domestic: 76@77 per cent, $6; 75 per cent, $5.25; 74@75 per cent, $5; 72 per cent, $4; 70 per cent, $3.50. Dull.

Tennessee, ground, 95 per cent through 100 mesh, basis 65 per cent B.P.L. (tri-calcium phosphate), $8 per short ton, with unit differential of 20c. per ton. Market getting active, but rains in corn belt making farmers postpone orders.

Potash—

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 90 per cent....	45.85	44.60
Sulphate of potash 90@95 per cent, basis 90 per cent....	45.85	44.60
Sulphate of potash-magnesia 48@53 per cent, basis 48 per cent	26.35	25.10
Manure salt 30 per cent....	21.00	18.00
Manure salt 20 per cent....	14.85	11.85
Kainit 14@16 per cent.....	11.75	8.75
Kainit 12.4 per cent.....	11.25..	8.25

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

Discounts: 5 per cent on minimum of 50 tons K_2O; 6 per cent on 100 tons; 7 per cent on 300 tons; 10 per cent on 500 tons. Prices guaranteed against sellers' decline until April 30, 1927.

Pumice Stone—In barrels, per lb., powdered, 2½@4c.; selected lumps, 5@7c.; lumps in bags, 3@5c.

Pyrites—Tharsis, per long ton unit of sulphur, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 13½c. Cinder from ore to remain property of buyers. Market improving.

[1]**Quartz Rock Crystals**—Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 40c. per lb. in ton lots. For optical purposes, double above prices.

Silica—Water ground and floated, per ton in bags f.o..b. Illinois: 400 mesh, $31; 350 mesh, $26; 250 mesh, $18.

Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$2.50; blast sand, $1.35@$4.

[1]**Spodumene**—$20@$30 per ton, depending upon lithium content. Nominal.

Sulphur—$18 per ton for domestic, f.o.b. *Texas* mines; $22 for export, f.a.s. Atlantic ports. Good shipment against contracts. Open prices $1 higher than above.

Talc—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $11; 96 per cent through 200 mesh, medium white, $10; packed in 50-lb. paper bags.

New York: Double air-floated, 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@$10, yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $10@$12; market fair.

Tripoli—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh: rose and cream colored, $16. Double ground through 110 mesh: rose and cream, $17. Air-floated through 200 mesh: rose and cream, $25; mill run, $15. Usual good fall business.

[1]**Zircon**—Freight allowed east of Mississippi River; 95 per cent, 3c. per lb., f.o.b. mines, in carload lots.

Mineral Products

Arsenious Oxide (white arsenic)—3¼c. per lb. London, £13@£13¼ per long ton.

Calcium Molybdate—$1.20 per lb. of contained Mo, delivered.

Copper Sulphate—4.90c. per lb. for either large or small crystals.

Sodium Nitrate—Spot, crude $2.34 per 100 lb. ex vessel, Atlantic ports. Futures, $2.36@$2.53.

Sodium Sulphate (Salt Cake)—Per ton, bulk, f.o.b. works, $20@$22.

Zinc Oxide—Per lb. in bags, in car lots: Lead-free, 7½c.; 10, 20 or 35 per cent leaded grades, 7½c.; French, red seal, 10½c.

Ferro-Alloys

[1]**Ferrocerium**—Per lb., $5.50.

Ferrochrome—1@2 per cent carbon, 23@25c. per lb. of contained chromium; 4 to 6 per cent carbon, 11½c. per lb. of contained chromium, delivered on contracts, freight allowed east of Mississippi River. Spot prices 12@12½c. per lb. Market active.

Ferromanganese — Domestic, 78@82 per cent, $88@$90 per gross ton furnace, prompt and future. British product held at $100, seaboard. Spiegeleisen, 19@21 per cent, $32@$34 f.o.b. furnace; 16@19 per cent, $31@$33.

Ferrophosphorus—Electrolytic, 18 per cent P, $91 per ton; 24 per cent, $122.50; f.o.b. Ala. and Tenn.

Ferrosilicon—Per gross ton, f.o.b. works, freight allowed east of Mississippi River: 50 per cent, $87.50 for spot, delivered in carload lots, $85 on contract. 75 per cent, $150 for spot; 14@16 per cent, $45. Heavy shipments.

Ferrotitanium—For 15 to 18 per cent material, $200 per ton, f.o.b. Niagara Falls, N. Y.

Ferrotungsten—$1.05 per lb. of contained W, f.o.b. works.

[1]**Ferro-uranium**—30 to 40 per cent U, $4.50 per lb. of U contained, f.o.b. works in 500-lb. lots.

Ferrovanadium—Per lb. of V contained, f.o.b. works, $3.40@$4, depending on grade, for spot; $3.25 @$3.75 on contract.

Metal Products

Rolled Copper—Sheets, 23c.; wire, 16¾c. per lb., f.o.b. mill.

Lead Sheets—Full rolled, 12½c. per lb.; c'ipped, 12¾c.

Nickel Silver—30c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal — Dimension sheets, 20¾c. per lb.; rods, 17¾c. per lb.

Zinc Sheets—11¾c. per lb., f.o.b. works.

Refractories

Chrome Brick—$45 per net ton, f.o.b. shipping point.

Fireclay Brick—First quality, $40@$43 per M., Ohio, Kentucky, Central Pennsylvania: second quality, $35@$40.

Magnesite Brick—9-in. straights, $65 per net ton, f.o.b. works.

Silica Brick—$40 per M. Pennsylvania and Ohio; $49@$52 Alabama and Illinois.

[1]**Zirkite**—Powdered, 80 per cent ZrO_2, 2½c. per lb. Brick, straights, 80c.@$1 each.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London		Sterling Exchange	
	1925	1926	1925	1926	1925	1926
January	68.447	67.795	32.197	31.322	477.702	485.295
February	68.472	66.773	32.245	30.797	476.886	485.852
March	67.808	65.880	31.935	30.299	477.279	485.606
April	66.899	64.409	31.372	29.682	479.034	485.702
May	67.580	65.075	31.276	30.125	484.960	485.485
June	69.106	65.481	31.863	30.248	485.353	486.000
July	69.442	64.793	31.954	29.861	485.514	485.755
August	70.240	62.380	32.268	28.773	485.264	485.293
September	71.570	.....	32.983	.....	484.270	.....
October	71.106	.....	32.972	.....	483.909	.....
November	69.223	.....	32.155	.....	484.201	.....
December	68.889	.....	31.835	.....	484.538	.....
Year	69.065	.....	32.088	.....	482.426	.....

New York quotations cents per ounce troy, 999 fine, foreign silver. London pence per ounce, sterling silver, 925 fine.

Copper

	New York		London			
	Electrolytic		Standard		Electrolytic	
	1925	1926	1925	1926	1925	1926
January	14.709	13.822	66.065	59.013	70.607	65.325
February	14.463	13.999	64.714	59.669	69.525	66.375
March	14.004	13.859	62.892	58.603	67.739	65.489
April	13.252	13.706	60.575	57.200	64.194	64.600
May	13.347	13.599	60.131	56.494	63.560	64.313
June	13.399	13.656	59.899	56.778	63.369	64.591
July	13.946	13.924	61.467	57.864	65.750	65.625
August	14.490	14.174	61.613	58.857	68.169	66.857
September	14.376	.....	61.886	.....	67.693	.....
October	14.300	.....	61.977	.....	67.523	.....
November	14.353	.....	61.280	.....	67.893	.....
December	13.866	.....	59.540	.....	65.625	.....
Year	14.042	.....	61.920	.....	68.804	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Lead

	New York		St. Louis		London		
	1925	1926	1925	1926	1925	1926	1926 3 M
January	10.169	9.255	9.953	9.102	41.443	34.778	34.584
February	9.428	9.154	9.126	8.991	37.944	33.903	33.903
March	8.914	8.386	8.578	8.165	36.804	31.625	31.921
April	8.005	7.971	7.662	7.764	32.791	28.775	29.284
May	7.985	7.751	7.780	7.538	32.283	28.253	28.731
June	8.321	8.033	8.024	7.876	33.479	29.986	30.142
July	8.151	8.499	8.054	8.383	34.698	31.716	31.545
August	9.192	8.908	9.284	8.722	38.188	32.756	32.345
September	9.508	.....	9.303	.....	38.884	.....	.....
October	9.513	.....	9.299	.....	39.017	.....	.....
November	9.739	.....	9.578	.....	36.872	.....	.....
December	9.310	.....	9.157	.....	34.739	.....	.....
Year	9.020	.....	8.817	.....	36.429	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York				London	
	99%		Straits			
	1925	1926	1925	1926	1925	1926
January	57.692	61.415	58.250	2.275	265.560	282.038
February	56.517	62.653	57.068	63.705	262.181	287.107
March	53.038	63.472	53.733	64.505	245.682	292.288
April	51.380	61.962	52.135	63.389	237.006	281.388
May	53.675	60.165	54.620	62.305	245.476	270.125
June	54.885	58.409	55.957	60.611	252.476	268.352
July	56.683	61.365	58.014	63.091	258.435	282.102
August	56.649	63.875	58.190	65.260	258.538	293.690
September	56.405	.....	58.247	.....	259.182	.....
October	60.462	.....	62.274	.....	277.722	.....
November	62.136	.....	63.304	.....	284.506	.....
December	61.952	.....	62.928	.....	284.920	.....
Year	56.790	.....	57.893	.....	260.974	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London		
			1925		1926
	1925	1926	Spot	1926	3 M
January	7.738	8.304	37.917	38.059	37.363
February	7.480	7.759	36.528	36.053	35.956
March	7.319	7.332	35.741	34.090	34.247
April	6.985	7.001	34.644	32.503	32.863
May	6.951	6.821	34.223	32.038	32.413
June	6.990	7.112	34.149	33.244	33.398
July	7.206	7.411	34.894	34.045	34.270
August	7.576	7.376	36.691	34.173	34.524
September	7.753	.....	37.435	.....	.....
October	8.282	.....	39.884	.....	.....
November	8.614	.....	39.039	.....	.....
December	8.565	.....	38.327	.....	.....
Year	7.622	.....	36.624	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

Antimony, Quicksilver and Platinum

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) Refined New York		Platinum (c) Crude New York
	1925	1926	1925	1926	1925	1926	1926
January	17.428	23.490	81.596	87.960	117.000	118.200	113.20
February	19.795	21.676	79.386	87.580	117.000	113.909	108.341
March	15.553	19.708	80.481	88.194	117.000	112.000	106.278
April	12.553	17.462	82.327	89.769	118.269	111.538	103.731
May	15.770	12.170	81.360	91.365	119.850	108.960	102.930
June	16.500	11.106	83.154	91.346	120.000	111.000	106.615
July	17.779	14.490	83.077	90.163	120.000	114.692	109.000
August	17.683	15.957	82.317	89.260	120.000	116.000	108.692
September	17.143	.....	81.730	.....	120.000	.....	.....
October	18.029	.....	83.856	.....	120.000	.....	.....
November	20.000	.....	88.250	.....	120.000	.....	.....
December	21.692	.....	90.000	.....	120.000	.....	.....
Year	17.494	.....	83.128	.....	119.093	.....	.....

(a) Antimony quotations in cents per pound for ordinary brands. (b) Quick silver in dollars per flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1925	1926	1925	1926	1925	1926
January	24.66	22.76	23.76	21.76	23.76	22.26
February	24.50	22.76	23.26	21.76	23.76	22.26
March	24.06	22.76	23.06	21.76	22.91	22.26
April	22.89	21.38	21.76	20.66	22.26	21.05
May	21.57	21.12	20.26	19.76	21.16	20.76
June	20.76	20.76	19.76	19.76	20.11	19.80
July	20.76	20.44	19.76	19.26	20.26	19.49
August	20.76	.....	19.76	.....	20.26	.....
September	21.04	.....	20.03	.....	20.50	.....
October	21.50	.....	20.37	.....	20.83	.....
November	22.64	.....	21.58	.....	22.08	.....
December	22.76	.....	21.76	.....	22.26	.....
Year	22.33	.....	21.26	.....	21.68	.....

In dollars per long ton.

Monthly Crude Copper Output in Short Tons

Domestic

	1926					
	Feb.	March	April	May	June	July
Alaska shipments	2,556	3,150	3,597	1,797	4,059	2,838
Butte & Superior	.....	1,243†	.....	.....	892†	.....
Calumet & Arizona	1,795	2,010	1,938	2,454	2,104	1,666
Magma	1,095	1,255	1,200	1,228	1,208	.....
Miami	2,109	2,336	2,302	2,298	2,241	2,200
New Cornelia	2,986	3,641	3,634	2,723	3,543	3,466
Nevada Con.	.....	9,774†	.....	.....	27,539†a	.....
Old Dominion	1,080	1,111	1,132	1,173	1,058	985
Phelps Dodge	6,949	7,440	7,033	7,566	6,786	6,775
Ray Con.	.....	17,840†	.....	.....	(a)	.....
United Verde Extension	1,764	1,784	1,730	1,997	1,908	1,738
Utah Copper	.....	26,736†	.....	.....	26,890†	.....
Tennessee Copper	503	543	520	555	521	543

Foreign

Boleo, Mexico	820	898	910	935	1,008	1,106
Furukawa, Japan	1,386	1,586	1,708	1,513	1,323	.....
Granby Cons., Canada	1,482	1,763	1,583	1,700	.....	1,777
Union Minière, Africa	6,810	7,097	7,050	7,547	7,427	7,716
Mount Lyell, Aust.	.....	2,002†	.....	.....	1,695	.....
Sumitomo, Japan	.....	.....	.....	.....	.....	.....

†Three months. (a) Included in Nevada Con.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1924		1925		1926	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	66,631	2,149	74,789	2,412	71,026	2,291
February	65,681	2,265	68,967	2,463	68,131	2,433
March	65,181	2,102	74,901	2,416	75,728	2,443
April	66,073	2,202	70,667	2,356	73,454	2,448
May	65,608	2,116	70,574	2,276	73,542	2,372
June	63,933	2,131	59,894	2,330	70,632	2,354
July	64,787	2,090	68,507	2,210	72,949	2,353
August	66,756	2,153	68,090	2,196	.....	.....
September	63,800	2,127	67,720	2,272	.....	.....
October	68,989	2,225	71,042	2,292	.....	.....
November	68,291	2,276	67,400	2,247	.....	.....
December	67,647	2,182	69,566	2,244	.....	.....
Total	793,377	.....	842,117	.....	505,462	.....
Monthly average	66,115	.....	70,176	.....	72,209	.....
Average of daily rate	.....	2,168	.....	2,307	.....	2,384

Record Volume of Business Expected This Fall

The general business situation continues to be very satisfactory, with every prospect of a record volume of trade during the fall, says the monthly bulletin of The National City Bank of New York, issued Sept. 2. Crop conditions promise final yields which, though not record-breaking, should yet afford a basis for very satisfactory business in the agricultural sections. Factory employment generally remains at high tide for the season, and pay-rolls which constitute the basis of buying power are running above a year ago. Retail distribution continues in large volume, as evidenced by the sales of chain systems, department stores, and mail order houses throughout the country.

Consumption of electric power and record breaking freight movement on the railroads reflect the high level of manufacturing and wholesale distribution. Bank checks drawn and cashed at banks make a good showing for recent months, the totals for the first three weeks of August rising 6 per cent above the corresponding period of 1925.

Commodity prices at wholesale continue to decline slowly and are now at the lowest level since 1924. So long as the decline is gradual the movement is not an unhealthy one, as its tendency is to enlarge the volume of consumption. The experience of the past year has clearly demonstrated that declining prices and business prosperity are not incompatible. Thanks partly to the policy of avoiding overstocking and to increased industrial efficiency these readjustments have been accomplished thus far with little rise in the business mortality rate, and with a continuance of high industrial profits.

Steel production keeps at a high level, reflecting a steady inflow of orders, as little steel apparently is being allowed to accumulate. Mills are operating approximately 80 per cent of capacity, with no unfavorable developments yet in sight. Despite evidence of somewhat more confident forward buying supplied by the Steel Corporation's rise in unfilled orders at the end of July, the trade maintains a conservative attitude, being influenced by the long period of unusual activity already enjoyed.

With the between season lull in automobile production, progress has been made in reducing stocks, and generally the industry appears to be in very satisfactory condition.

Although the volume of work already under way is enough to insure active building for some time to come, and new contracting will doubtless continue to go forward in substantial volume, it seems increasingly probable that building operations are nearing a period of some decline.

The coal strike is still an overshadowing factor in the British industrial situation. It has lasted four months, and little definite progress appears to have been made toward an agreement, although there are signs of disintegration in the miners' organization. It may be that the best possible outcome is to have a gradual resumption of work by independent agreements in the several districts, between individual operators and their employees; in other words, a scrapping of organization on both sides. An old-fashioned struggle for the elimination of the uneconomic mines would clear up the situation.

Reparation payments of course delay the recovery of Germany, retarding the accumulation of capital, with the loss of the benefits which would accrue therefrom, but there is reason to believe that Germany is making substantial gains, notwithstanding.

Imports and Exports of Ores and Metals in July, 1925 and 1926

Compiled from U. S. Department of Commerce Records

In pounds unless otherwise stated

Imports

	July, 1925	July, 1926
Antimony		
Ore { Gross weight	640,072	.....
Ore { Antimony content	279,325	.....
Liquated regulus or metal	2,078,493	2,867,960
Copper		
Ore	6,889,027	14,025,425
Concentrates	3,618,005	5,612,111
Regulus, coarse metal, cement copper	14,955	410,697
Imported from:		
Spain	1,168,317	3,721,899
Canada	4,191,219	5,444,129
Mexico	1,798,130	2,477,334
Cuba	1,825,600	4,295,884
Chile	1,320,680	2,891,810
Peru	105,657	148,265
Other countries	112,384	1,068,912
Unrefined black, blister and converter copper in pigs, bars, etc	33,592,846	40,363,783
Imported from:		
Spain	809,086	4,175,817
Canada	4,226,614	4,591,722
Mexico	5,739,709	8,601,194
Chile	9,026,670	3,718,795
Peru	5,941,583	2,736,381
Portuguese Africa	7,849,184	3,547,681
Other countries	.....	12,992,193
Refined copper	4,463,684	8,616,465
Old and clippings for remanufacture	458,729	1,488,610
Composition metal, copper chief value	22,252	.....
Brass		
Old and clippings for remanufacture	722,729	1,015,884
Lead		
Ore and matte	6,125,561	16,034,217
Bullion or base bullion	4,895,488	19,609,915
Pigs and bars	1,918,101	4,828,070
Scrap lead, babbitt metal, solder, and other forms	52,055	255,257
Type metal and antimonial lead { Gross weight	.....	604,210
Type metal and antimonial lead { Lead content	.....	412,786
Manganese ore, tons { Gross weight	1,923	200
Manganese ore, tons { Manganese content	25,683	34,133
Pyrites, tons	31,049	50,193
Tin		
Ore, tons	1	8
Bars, blocks, and pigs	15,085,616	17,787,102
Imported from:		
United Kingdom	4,895,100	2,481,351
British Malaya	7,097,479	12,076,627
China	280,347	.....
Dutch E. Indies	.....	949,152
Hongkong	807,763	.....
Australia	11,200	235,200
Other countries	1,993,727	2,044,772
Zinc		
Ore, zinc content	221,840	2,054,162
Blocks, pigs, and old	19,359	2,087

Exports of Copper, Lead and Zinc

	July, 1925	July, 1926
Copper		
Ores, concentrates, composition metal. and unrefined	203,865	200,278
Refined in ingots, bars, and other forms	97,132,022	63,268,481
Exported to:		
Belgium	11,005,636	6,379,858
France	13,232,676	7,398,536
Germany	25,918,806	11,840,770
Italy	17,232,602	5,588,783
Netherlands	5,906,353	6,116,055
Spain	459,913	268,818
Sweden	2,744,372	1,866,198
United Kingdom	15,128,184	15,091,085
Other Europe	2,279,890	4,390,580
Canada	2,445,539	1,957,367
Japan	448,024	1,343,922
Other countries	330,027	1,026,509
Old and scrap	1,057,660	1,099,404
Pipes and tubes	175,988	252,260
Plates and sheets	695,484	416,882
Rods	5,098,241	3,528,301
Wire	547,671	2,033,960
Insulated copper wire and cable	1,223,298	1,533,569
Lead		
In pigs, bars, and other forms:		
From domestic ore	337,765	164,115
From foreign ore	17,983,903	15,159,714
Exported to:		
Belgium	448,157	448,166
France	1,680,412	1,669,127
Germany	4,179,398	2,856,603
Italy	56,020	.....
Netherlands	672,145	168,074
United Kingdom	9,308,278	4,259,839
Other Europe	224,211	448,054
Brazil	.....	224,048
Other South America	605,805	274,924
Japan	560,022	4,201,729
Other countries	587,220	773,265
Other lead manufactures	1,568,979	1,384,625
Zinc:		
Ore and concentrates, tons	7,190	3,995
Dross	2,224,837	2,256,566
Cast in slabs, blicks, or pigs	18,342,606	11,590,054
Exported to:		
Belgium	811,983	280,033
France	2,700,130	.....
Germany	714,169	1,068,814
Italy	2,252,355	280,049
Netherlands	235,425	85,050
United Kingdom	10,663,833	6,292,724
Other Europe	224,196	123,199
Argentina	56,018	.....
British India	114,522	134,409
Other countries	569,975	3,325,776
Sheets, strips, other forms	917,688	537,996
Dust	382,284	275,662
Other zinc manufactures	50,763	124,910

Mining Stocks—Week Ended August 28, 1926

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	50⅛	49	49⅜	Jy.17, Au.23 Q	0.75
Arcadian Consol.	Boston	1	1	1		
Ariz. Com'l	Boston	12	11⅛	11½	Jy. 16, Jy. 30	0.50
Calaveras	N. Y. Curb	1⅛	1	1⅛		
Calumet & Arizona	New York	71⅛	69	71	Se. 4, Se. 20 Q	1.50
Calumet & Hecla	Boston	18	17⅛	17⅜	Au.31, Se.15 Q	0.50
Cerro de Pasco	New York	70⅛	68⅛	69⅛	Jy. 15, Au.2, Q	1.00
Chile Copper	New York	34	33⅛	33⅜	Se.1, Se.27, Q	0.62½
Chino	New York			22	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	3½	3½	3½		
Copper Range	Boston	17	16½	16⅜	May, 1925	1.00
Crystal Copper	Boston Curb	*40	*31	*39		
East Butte	Boston	3⅛	3⅛	3⅛	Dec., 1919	0.50
First National	Boston Curb	*23	*18	*19	Feb., 1919	0.15
Franklin	Boston			*35		
Granby Consol	New York	25½	24⅛	24⅞	May, 1919	1.25
Greene-Cananea	New York	21⅛	20⅛	21	Nov., 1920	0.50
Hancock	Boston			1		
Howe Sound	New York	41⅞	37⅛	41	Ap.1, Ap.15	0.75
Inspiration Consl.	New York	24⅞	24⅛	24⅛	Se.16, Oc.4, Q	0.50
Iron Cap	Boston Curb	3⅛	3⅛	3⅛	Jn. 1, Jn. 15	0.50
Isle Royale	Boston	13	12⅛	12⅜	Jn. 1, Jn. 15	0.50
Jerome Verde Dev	N. Y. Curb			*58		
Kennecott	New York	57⅛	56⅛	56⅛	Sept. 3, Oct. 1 Q	1.00
Lake Copper	Boston			1	June, 1925	0.50
Magma Copper	New York	40⅛	38⅞	38⅞	Jn.30, July.15, Q	0.75
Mason Valley	N. Y. Curb	2⅛	2⅛	2⅛		
Mass Consolidated	Boston	45	35	35	Nov., 1917	1.00
Miami Copper	New York	15	14⅛	14⅛	Aug.2, Aug.16 Q	0.25
Mohawk	Boston	40⅜	40	40	Jy.31, Se 1 Q	1.00
Mother Lode Coa	New York	6⅛	6	6	Jn. 15, Jn. 30	0.37½
Nevada Consol	New York	13⅛	13⅛	13⅜	Jn. 15, Jn. 30 Q	0.25
New Cornelia	Boston	23⅛	22	22	Au.6, Au.23 Q	0.04
North Butte	Boston	2⅛	2⅛	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*59	*56	*59⅛	Se. 1, Se. 15	0.05
Old Dominion	Boston	17⅛	17⅛	17⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†140	†136		Jun.22, July2 Q	1.50
Quincy	Boston	21	19⅛	19⅛	Mar., 1920	1.00
Ray Consolidated	New York	14⅛	14	14⅛	Ap.20, Ap.30	0.25
Ray Hercules	N. Y. Curb			11⅞		
St. Mary's Min. Ld.	Boston	31	29⅛	29⅛	Ap.17, My.18	2.00
Seneca Copper	New York	5	5	5		
Shannon	Boston	50	45	45	Nov., 1917	0.25
Shattuck-Denn	Boston Curb	6⅛	6⅛	6⅛		
Superior & Boston	Boston	65	60	60		
Tenn. C. & C.	New York	11⅛	11⅛	11⅛	Au.31, Se.15, Q	0.25
United Verde Ex	N. Y. Curb	28⅛	27⅛	27⅛	Jy.17, Aug. 2,	0.75
Utah Copper	New York			104⅛	Jn.15, Jn.31 Q	1.25
Utah Metal & T	Boston	1⅛	1	1	Dec., 1917	0.30
Victoria	Boston	65	55	55		
Walker Mining	Salt Lake	*76	*67	*67		
NICKEL-COPPER						
Internat. Nickel	New York	37⅛	35⅜	36⅛	Je.17, Je.30,	0.50
Internat. Nickel, pfd.	New York	102	102	102	Jy.12, Au.12,	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*31⅛	*30½	*31	Jy. 10, Au.10	0.01½
National Lead	New York	160	158½	158½	Jn. 11, Jn. 30 Q	2.00
National Lead pfd.	New York	117½	117½	117½	My.21, Je.15 Q	1.75
St. Joseph Lead	New York	45	43	43	Jn.10, Jn.21 QX	0.75
ZINC						
Am. Z. L. & S.	New York	6⅜	6⅛	6⅜	May., 1920	1.00⅞
Am. Z. L. & S. pfd.	New York	31	30⅜	30⅜	Nov., 1920	1.50
Butte C. & Z.	New York	5⅛	5	5⅛	De.10, De.24	0.50
Butte & Superior	New York	10⅛	10⅛	10⅛	Jn.15, Jn.30 Q	0.50
Callahan Zn-Ld	New York	2	1⅞	1⅞	Dec., 1920	0.50
Eagle Picher	Cincinnati	31⅜	31⅛	31⅛	Au.14, Se.1 Q	0.40
Eagle Picher, pfd.	Cincinnati			110	Aug.20, Sept.15 Q	1.75
New Jersey Zn	N. Y. Curb			208	July20, Aug.10 Q	2.00
United Zinc	N. Y. Curb			*70		
Yellow Pine	Los Angeles	*12	*12	*12	De.8, De.18 Q	0.04
GOLD						
Alaska Juneau	New York	1⅛	1⅛	1⅛		
Argonaut	Toronto	*32	*23⅞	*29		
Barry-Hollinger	Toronto	*70	*64⅓	*67		
Carson Hill	Boston			*22		
Consol. W. Dome L.	Toronto	*25	*20¼	*23		
Cresson Consol. G.	N. Y. Curb	2⅞	2⅞	2⅞	Mh.31, Ap 10	0.10
Crown Reserve	Toronto	*11	*9½	*10½	Jan., 1917	0.05
Dome Mines	New York	11⅛	11	11	Jn.30, July 20, Q	0.50
Golden Center	N. Y. Curb	2½	2	2⅜		
Golden Cycle	Colo. Springs			1.52	Nov.30, Dec.10 Q	0.03
Hollinger Consol	Toronto	19.45	19.30	19.35	Au.24, Se. 9 Q	0.10
Homestake Mining	New York	57½	57	57	Au.20, Au.25 M	0.50
Kirkland Lake	Toronto	1.15	1.00	1.13		
Lake Shore	Toronto	14.75	14.15	14.60	Se.1, Se. 15 Q	0.10
McIntyre-Porcupine	New York			26	Au.2, Se.1 Q	0.25
Newray	Toronto	*35	*33½	*35		
Noranda	N. Y. Curb	19⅛	19	19⅛		
Night Hawk Pen	Toronto	*6½	*6	*6½		
Portland	Colo. Springs			*43½	July5, July15	0.02
Rand Mines	New York	36	36	36	Au.23-30 Am.Sh.	1.52
Teck-Hughes	Toronto	4.75	4.46	4.58	Jy. 15, Au 2	0.05
Tom Reed	Los Angeles			*50	Ma.10 Ma.20	0.02
Tough-Oakes	Toronto	*55	*48	*49		
United Eastern	N. Y. Curb	*35	*33	*33	July, 1924	0.05
Vipond Cons.	Toronto	1.97	1.84	1.90		
Wright-Hargreaves	Toronto	8.75	8.65	8.75	Jn.15, Jy.1 Q X	0.07½
Yukon-Alaska Trust	N. Y. Curb			21		
GOLD AND SILVER						
Carnegie Metals	Boston	13	13	13		
Con. Cortez	N. Y. Curb	*14	*10	*12		
Con. Virginia	San Francisco	*10½	*9½	*10½		
Continental Mines	N. Y. Curb			*45		
Dolores Esperanza	N. Y. Curb			*39	July, 1923	0.05
Premier Gold	N. Y. Curb	2½	2⅛	2⅛	Jn.18, Jy.3 Q	0.08
Tonopah Belmont	N. Y. Curb	2 1/16	2 1/16	2 1/16	Se.15, Oc.1	0.05
Tonopah Extension	N. Y. Curb	*50	*46	*46	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	5⅛	5⅛	5⅛	Ap.7, Ap.21 Q	0.07½
Unity Gold	N. Y. Curb			*30		
West End Consol	N. Y. Curb	*18	*17	*18	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*20	June, 1918	0.02

Stock	Exch.	High	Low	Last		Last Div.
SILVER						
Alvarado	N. Y. Curb			1	Oct., 1920	0.50
Beaver Consol	Toronto	*81	*76	*81	May. 1920	0.03
Castle-Trethewey	Toronto	1.45	1.42	1.42		
Coniagas	Toronto	4.85	4.47	4.50	May, 1924	0.12½
Keeley	Toronto	1.77	1.69	1.72	Se 1, Se.15 X	0.12
Kerr Lake	N. Y. Curb	1⅛	1⅛	1⅛	Ap.1, Ap.15	0.12½
La Rose	Toronto	*7½	*7	*7⅛	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto			*50	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*14	*12	*12⅛	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.95	3.85	3.88	Jy.1, Jy.15	0.12½
Nipissing	N. Y. Curb	7⅛	5⅛	6⅛	Jn.30, Jy.20	0.15
Temiskaming	Toronto			*50	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	8	7⅛	8	Jn.18, Jy.5, Q X	0.25
Alta Merger	Salt Lake	†*8	†*3			
Bingham Mines	Boston	43⅛	37	43⅛	Jn.19, Jn.30 Q	1.00
Cardiff M. & M.	Salt Lake	*41	*41	*41	De.16, No.18	0.10
Chief Consol	Salt Lake			3.00	Jy.10, Au 10 Q	0.10
Cleveland-Cliffs Iron	Cleveland	†*82	†*80			
Emma Silver	Salt Lake	†1	†*50			
Erupcion	Boston Curb	1⅛	1⅛	1⅛	Jn.18, Jy.5, QX	0.10
Federal M. & S.	New York			81		
Federal M. & S., pfd.	New York	77½	73⅛	73⅛	Au.25, Se.15 Q	1.75
Hawthorne Mines	N. Y. Curb	*15	*13	*15		
Hecla Mining	N. Y. Curb	18	17⅞	17⅞	Au.14, Se.15 Q	0.50
Iron King Mining	Salt Lake	*21	*21	*21		
Keystone Mining	Salt Lake	†32	†27		Au.12, Au.26	0.07½
Lucky Jim	Spokane	*17½	*16½	*16½		
Lucky-Tiger Com.	Kansas City	†9.10	†8.90		Au.10, Au.20 X	0.07
Mammoth Mining	Salt Lake	2.85	2.85	2.85	Mar.24, Apr. 1	0.10
Marsh Mines	Spokane	3.25	2.75	3.65	Se.15, Oc.1	0.15
Park Utah	New York	6.60	6.60	6.60	Jn.15, Jy.1 Q	0.15
Plutus Mining	Salt Lake			1.75	July 15	0.10
Prince Cons.	Salt Lake	1	*75	*75		
Silver King Coal.	Salt Lake	8.65	8.60	8.60	Jn.21, July1, Q	0.25
Silversmith	Spokane	*49⅜	*43	*49¾	Jn.30, Jy.10 Q	0.02
Tamarack-Custer	Spokane	*28⅛	*27	*27	Sept., 1924	0.25
Tintic Standard	Salt Lake	12.75	12.50	12.50	Jn.16, Jn.26,	0.40
Utah-Apex	Boston	8⅛	8	8	Jy. 3, Jy.15 Q	0.25
Western Utah Copper	N. Y. Curb	*5	*5	*5		
IRON						
Bethlehem Steel	New York	47⅓	46	47⅓	July, 1924	1.25
Colorado Fuel & Iron	New York	44⅓	42	43⅓	May, 1921	0.75
Gt. North'n Iron Ore	New York	22⅓	20⅓	20⅞	De. 4, De. 28,	0.75
Inland Steel	New York	42⅜	41⅛	41⅜	Au.13, Se.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅛	1⅛	1⅛		
Replogle Steel	New York	10⅛	9⅞	10⅛		
Republic I. & S.	New York	59⅜	57⅛	58⅛	Au.14, Se.1	1.00
Republic I. & S. pfd.	New York	98	97⅛	97⅛	Se.15, Oc.1 Q	1.75
Sloss-Sheffield S. & I.	New York	133⅛	126	133⅛	Jn.10, Jn.21 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	104	104	104	Jn.21, July.1, Q	1.75
U. S. Steel	New York	153	146⅜	150⅜	Se.2, Se.29 Q	1.75
U. S. Steel pfd.	New York	128⅜	126⅜	127⅛	Au.3, Au.30, Q	1.75
Virginia I. C. & C.	New York	47	46	46⅛	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York			70	Jn.1, July 2,	2.50
ALUMINUM						
Alum. Co. of Amer.	N.Y.Curb	71⅛	69⅛	69⅛		
Alum. Co. of Amer pf.	N.Y.Curb			101½	June 15, July 1, Q	1.50
VANADIUM						
Vanadium Corp.	New York	41	39⅜	39½	Au.2, Au 16, Q	0.75
ASBESTOS						
Asbestos Corp., New	Montreal	21⅞	17⅜	21⅛	De.31, Jn.15 Q	1.50
Asbestos Corp., pfd.	Montreal	75⅛	71	74	Jy.1, Jy.15, Q	1.75
SULPHUR						
Freeport Texas	New York	27⅛	25⅛	26	Nov., 1919	1.00
Texas Gulf	New York	171⅛	164	171⅛	Se 7, Se. 15, Q	3.00
DIAMONDS						
De Beers Consol.	New York			35⅛	Ju.16, Ju 17	1.70
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	4⅛	4⅛	4⅛		
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	51⅛	51	51	Au 20, Se. 1, Q	1.00
Amer. Metal pfd	New York			116	Au 21, Se 10	1.75
Amer. Sm. & Ref.	New York	147⅛	140⅛	144⅛	Jy.10, Au 2, Q	1.75
Amer. Sm.&Ref.pfd.	New York	120	120	120	Au 7, Se 1, Q	1.75
Consol. M. & S.	N. Y. Curb			2.20	Jn.30, Jy.5 QX	3.75
Federated Metals	N. Y. Curb	13⅜	13⅜	13⅜		
Newmont Mining	N. Y. Curb	66⅛	65⅛	66⅛	Mar.31, Apr.15, Q	0.60
Southwest Metals	N. Y. Curb			1		
U. S. Sm. R. & M.	New York	38	37⅛	38	Jy. 7, Jy. 15, Q	0.87½
U. S. Sm. R.&M.pfd.	New York	47⅛	47⅛	47⅛	Jy. 7, Jy. 15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange; Henry Sachs, Colorado Springs, Colo.

PRICE WEEK ENDED AUG. 18, 1926

Name	High	Low	Last		Last Divd. Date	Amount
Aramayo Mines (25 frs.)	81/3	77/6	77/6	Aug.	1926	15 p.c.†
British Platinum (£1)	5/3	4/—	4/6	Feb.	1925	2½ p.c.
Burma Corpn. (10 rupees)	16/10½	16/3	16/4½	Aug.	1926	7 annas*
Bwana M'Kubwa (5s)	7/6	6/9	7/3			
Camp Bird (2s)	4/7½	3/9	4/6			
El Oro (£1)	8/7½	8/—	8/3	Nov.	1924	2½ p.c.*
Esperanza (10s)	1/5	—/8	1/—			
Frontino & Bolivia (£1)	6/6	6/3	6/3	July	1926	2½ p.c.
Mexican Corpn. (£1)	14/10½	13/—	13/9			
Mexico Mines of El Oro (£1)	25/—	24/—	25/—	June	1926	7½ p.c.*
Oroville Dredging (£1)	3/10½	3/6	3/9	Dec.	1923	3¾ p.c.
Ouro Preto (£1)	2/—	1/10½	2/—	May	1925	2½ p.c.
Rhodesian Congo Border (£1)	112/6	102/6	107/6			
St. John del Rey (£1)	9/6	8/9	9/3	June	1925	6¼ p.c.
San Francisco Mines (10s)	32/6	30/10½	31/6	June	1926	15 p.c.
Santa Gertrudis (£1)	17/6	15/6	16/6	July	1926	5 p.c.
Selukwe (2s. 6d.)	12/10½	11/6	12/—	April	1917	6¾ p.c.
S. Amer. Copper (2s.)	4/6	4/1½	4/3	Nov.	1917	75 p.c.
Tanganvika (£1)	44/3	40/—	41/3	Aug.	1926	7½ p.c.
Tomboy (£1)	4/3	4/—	4/—	July	1926	10 p.c.
Union Miniere du Haut-Katanga (Brussels)	9.500	9.400	9.475	July	1926	175 frs.‡

* Free of British income tax. † Swiss frs. ‡ Belgian frs.

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September 11, 1926

Petroleum in Albania

By Arthur Huber Redfield

Two-thirds of this newest of oil countries was unknown when the World War began. Despite the many indications of petroleum and natural gas, no prospecting had been done. Recent study of its resources was followed by the granting of six concessions to foreign companies. Of these, the Anglo-Persian began drilling last October and is now reliably reported to have brought in a well near Patoz in July

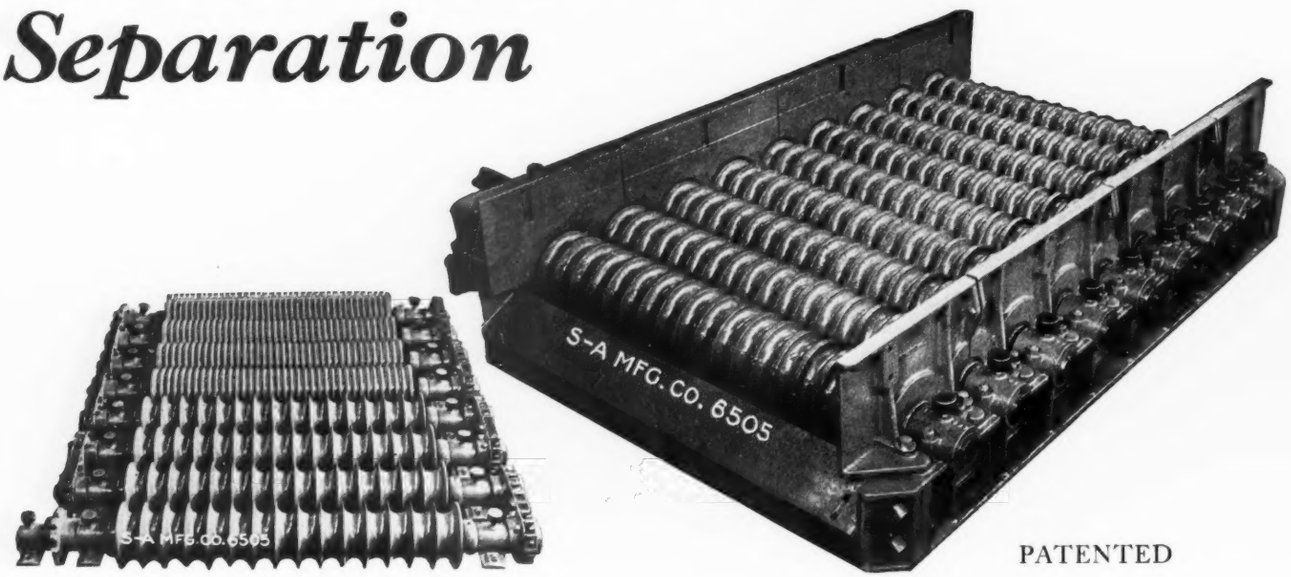
Coke-burning Ignition Stoves for Sintering Machines

By Robert Wallace

Proposed Ground Classification for Mining Purposes - II

By G. Townsend Harley

A "Live Roll" Principle that Gives the Utmost in Separation



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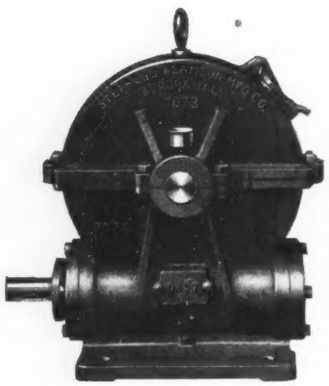

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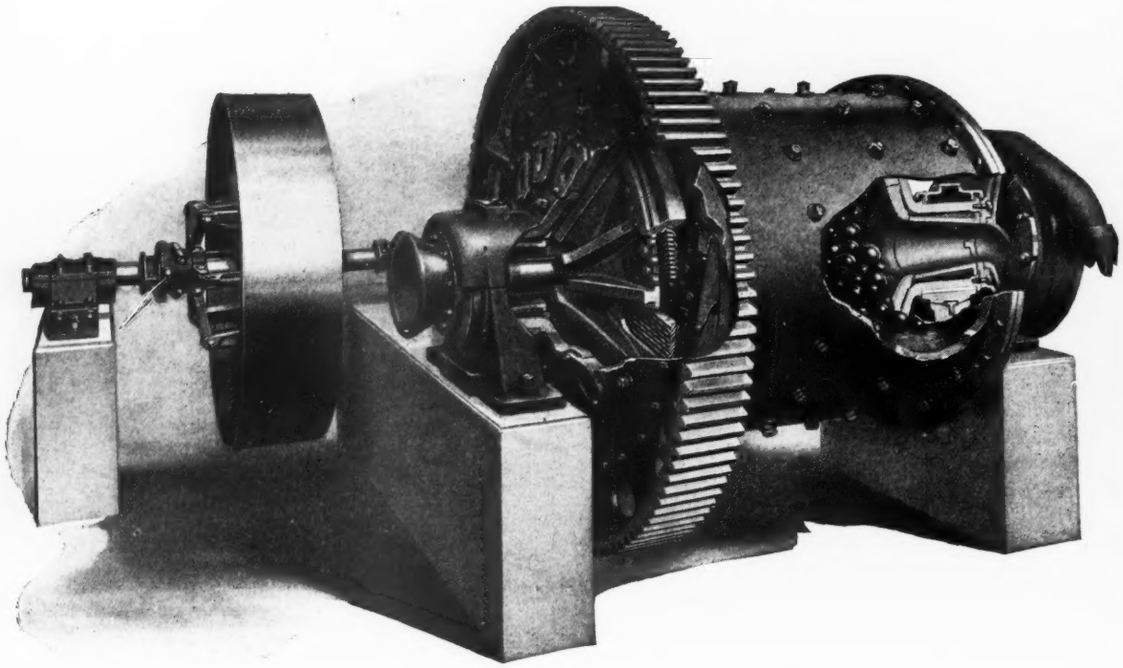

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ENGINEERING AND
MINING JOURNAL

JOSIAH EDWARD SPURR, Editor

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Finding Fault with the Copper Export Association

LONDON METAL DEALERS do not take kindly to the reorganization of the Copper Export Association, which they fear will put a serious crimp in their business by selling direct to consumers. They have found considerable fault with the proposals already made by its sponsors, and interpret the postponement in the corporate functioning of the association as good news for all concerned. Witness the weekly market report of Brandeis, Goldschmidt & Co. for Aug. 14:

"There is good reason to believe that the new Copper Trading Association scheme has been shelved—if not for good, anyhow for some time to come. This will no doubt, give a better tone to the market. It is difficult to believe that an association, which was going to restrict the facilities of buyers and artificially hold up prices, was going to stimulate consumption; on the contrary, any extension of manufacturing works would be actually put off, as long as this threat was overhanging the market and consumption restricted by the uncertainty of getting supplies of raw material at reasonable prices and the necessary credits required to keep their works going. Copper is, both as regards the statistical position and level of prices, in such an excellent condition that no artificial stimulus is required to help the market."

There seems no reason for believing that the association has been shelved, either temporarily or permanently. Reports of the early consummation of the plan were ill advised, for many details in such an organization must be perfected and approval must be secured not only from as many of the large copper producers as possible but also from government agencies without whose co-operation the association could not have a smooth existence. Mr. T. Wolfson, who has just returned from Europe, reports that important foreign producers of copper have been converted to the advantages of the proposed association; and it is to be presumed that it will begin functioning as a corporate entity as soon as the proper United States and foreign government officials have signified their approval of the scheme as it has been outlined to them.

It should not be the purpose of the association to boost the price of copper artificially, "to restrict the facilities of buyers," nor to add to "the uncertainty of getting supplies," as our London friends would have the consumers believe. Rather is it the aim, as interpreted here, to prevent artificial fluctuations in the price of the metal based on speculative holdings; to sell direct to consumers without the necessity of paying commissions to middlemen; and to assure plentiful supplies at all times at convenient points so that it will be unnecessary for consumers to worry about future requirements of their raw material or the prices they will have to pay for it. It would be manifestly unwise to make it increasingly difficult for consumers to get copper, or to have prices so high as to discourage consumption. Manufacturers of copper products, in the United States at least, prefer stable prices; they can make just as much money, perhaps more, with copper firmly at 15c. per lb. as with the metal unstable at one or two cents less. They are satisfied if assured that no one else is getting his metal for less than they are paying. It is market stability rather than a hold-up that the new copper export association is planning.

Mr. Doherty Replies to Mr. Hughes

POINTED REPLY has come from Henry L. Doherty to the statements made by Charles E. Hughes before the Federal Oil Conservation Board last spring. Then, it will be remembered, Mr. Hughes appeared as representative of the American Petroleum Institute and the substance of his brief was, in large part, simply a reiteration of the assertion of the Institute's Committee of Eleven that oil was abundant and that there was no need at all of conservation measures. Those who had the welfare of the country at heart and a proper regard for its future and who saw cause for apprehension in the reckless overproduction of such a vital resource as oil, doubtless had resented the bland assertion of the Committee of Eleven in its report that there was nothing to be disturbed about. So illogical in places was the reasoning in this report that it seemed patently an effort to pull the wool over the public's eyes. Any doubt that this move of the Committee was simply a maneuver and not a straightforward effort to enlighten the public became conviction when Mr. Hughes, an able attorney but wholly unversed in petroleum technology and economics, was employed to speak for the Institute before the Conservation Board—as if among petroleum men there could not be found an able spokesman. Mr. Hughes' name was evidently expected to accomplish what Mr. Hughes' ignorance of petroleum could not.

Mr. Doherty's reply is given in the formal answer to Mr. Hughes' brief which he has filed by permission of the Board. Mr. Hughes' statement, he says, "is apparently nothing more than his own rearrangement of the matters handed him by the oil lawyers." Going further, after saying that Mr. Hughes' "seeming indorsement of the report of the Committee of Eleven" makes it necessary to say whether this report is true or not, he declares "There is not a single petroleum engineer, even though he may be engaged in trying to sustain the position of the Committee of Eleven, who does not know that this report is untrue. The mere mention of the report of the Committee of Eleven before any meeting of the petroleum scientific men is always sure to provoke a snicker that nothing will suppress." Reiterating his criticism of waste that might be avoided by rational methods he says: "A new pool has been opened in Texas. The waste of gas alone is something appalling. It is common talk among oil men that the gas being blown in the air is in excess of 500 million cubic feet per day." Denying that the Federal Government lacks power to legislate he says: "It is my un-

qualified belief that Congress has power under the Constitutional provisions to provide for the common defense."

Granted that there may be honest difference of opinion as to whether conservation measures are desirable and feasible or not, certain it is that the report of the Committee of Eleven and the argument of its spokesman based on it are decidedly open to question.

Water and Magmas

THERE ARE MANY SIGNS that the inquiry into the nature and origin of ore deposits has had a renaissance, having burst the bounds of a settled tradition with which it had been fettered. Certain assumptions have been made for so long a time that they had become accepted facts, even axioms; and yet they were assumptions, mere hypotheses, expressions of working theories, or hardly that. Such was the assumption of water as the chief agent of ore carriage and ore deposition, and the further assumption of dilute solutions and long and gradual building up of orebodies. The phenomenon actually observed in nature was the evidence of high fluidity of certain ore solutions, and instead of "fluid" it become customary to say "aqueous," on account of the long-standing hypothesis of water as the great agent.

Geologists are now noting the fact that the fluidity of ore solutions may not be due, after all, to water, so familiar as a superficial fluid, and emitted in great quantities from volcanoes. As to magmatic water, it appears certain that much of the water exhaled from volcanoes and from cooling lavas is due to the burning of oxygen and other reactions which depend on the oxidation of the air, as the lava nears or reaches the surface. Indeed, the whole question of primitive magmatic water needs a complete overhauling and an appraisal of actual evidence. The deposition of hydrous minerals which has taken place under certain circumstances in depth would seem to substantiate the theory of abundant magmatic water at these depths; but the question remains whether the water was the result of chemical reactions which precipitated the minerals, or existed previously and independently. Certain ore deposits show no indication of water, either within themselves or as wall-rock alterations. Others show evidence which still permits the hypothesis that water was present, in a greatly varying degree. But evidence of a solution having been fluid, even highly so, is not sufficient reason to call the solution aqueous. Fluidity in ore solutions or ore magmas is generally to be conceived of as due to gases, of which water gas is only one.

Claim Jumping, A Misdemeanor

IN NEW MEXICO a claim jumper was recently given a sentence of six months in the penitentiary and a $100 fine, according to the *Silver Belt*, of Miami, Ariz. This is in accordance with Section 3454 of the New Mexico law which classifies the act of claim jumping as a misdemeanor, thus bringing it within the jurisdiction of any local justice of the peace. The laws further provide that the justice of the peace court shall have jurisdiction by providing that title is not an issue in claim jumping, and in fact cannot even be discussed. Under the New Mexican code, the only issue is the actual act of the jumper and even though the plaintiff has not complied with all of the requirements of law, the fact that he is in possession and is the owner of record, is all that is required of him to appeal to this protective law and get a speedy remedy. The law provides a minimum imprisonment of six months and a maximum of one year, together with adequate fines. The sentence in this case will have a salutary effect on other would-be aggressors, for it is well known that prospectors and owners of unpatented mining claims have been sufferers from the evils of claim jumping. In the early days, and days not so far distant, the remedy was often summary and drastic, in the form of shot-gun relief, which, backed by the moral support of the camp, afforded a perfect remedy.

No Glut of Platinum Yet

LOCAL FOLLOWERS of the platinum market have so far refused to be stampeded by the threat of an enormous production from the recently discovered fields in the Transvaal. Though platinum has sold for a long time at comparatively high levels compared with pre-war prices, those levels have been well maintained in recent weeks; in fact, the price has actually been advanced by the leading interest, which now quotes $116 per oz. Certainly there is no reason to be alarmed at the July output of the Transvaal Platinum Co., which recovered only 70 oz. of platinum and allied metals, out of 873 tons of ore milled. In June, 104 oz. was recovered from 817 tons of ore. It is reported that the losses in treatment are larger than they should be and that no means to remedy them has so far been developed. Platinum fully deserves its place among the noble metals; it is scarce, enduring, difficult to recover from its ores by any ordinary means, and particularly difficult for the ordinary chemist even to assay accurately. It is not likely to be a cheap metal for a long time to come even if other ore deposits as important as those in the Transvaal are discovered.

A Plea for More Informative Company Reports

UNDER THE CAPTION "Stop, Look, Listen!" William Z. Ripley in the current number of the *Atlantic Monthly*, has again rendered a constructive service to the investor in corporate securities and also to corporation managements in general. In a former article he attacked the insidious evil of non-voting stock and now in an equally frank article he espouses the shareholders' right to adequate information about company affairs.

Undoubtedly the trend in the better managed corporations is toward a reasonable and fair publicity of the internal condition at regular intervals. There are many examples of corporation and company reports that adequately inform the stockholder, but there are also many that do not. The larger mining companies with few exceptions have held to the practice of publishing annual and quarterly reports that are above criticism but with the smaller companies there is much to be desired. Numbers of stockholders are not interested in their company's reports and are therefore more or less responsible for any malpractice that has occurred. Nevertheless it is important that frank, full reports be rendered whenever there is a departure from the routine of the company's business, such as consolidation with other

companies, the appropriation of funds for the purchase of properties, or the embarking in a new business not in line with its normal activities. It is chiefly through these three avenues that treasuries are bled and difficulties engendered. A company which does not publish a full statement of its condition to its stockholders is open to suspicion that there is manipulation of its affairs, that coups on the stock market for the benefit of insiders are under way, or that evasion of some kind is being practiced. Perhaps intense competition may excuse instances where incomplete reports are made, but examples of this are the exception.

Dr. Ripley states that stockholders are entitled to adequate information, and the state and the general public have a right to the same privilege. He points out the relation of corporate publicity to industrial efficiency and the necessity of the disclosure of internal condition before true prices on the securities markets can be determined. The loose handling of maintenance, depreciation and depletion accounts is analyzed. Dr. Ripley says: "At the threshold of intelligent corporate publicity stands a clear distinction between capital and income." He points out the need, as the first corrective of incomplete and misleading reports, for rigorous private initiative from within and suggests that stockholders should either boycott the sealed-up corporations or force the issue in open meeting. In his opinion state legislation for the enforcement of publicity holds out little promise, but he points out that the Federal Trade Commission Law delegates specific authority to the Federal Trade Commission that is adequate to secure reasonable publicity.

There is much meat in Dr. Ripley's article and corporation managements as well as stockholders can study it with profit, for upon the integrity and fairness of corporation management depend the success of industry.

Why Not An American Antimony Smelter?

WHEN THE PRICE of a commodity reaches abnormally high levels, supplies are wont to appear from unheralded sources. This happened with arsenic a few years ago, when a lot of potential producers appeared, anxious to help provide the world with all that its inhabitants needed, at from 10 to 15c. per pound. More recently, with antimony prices varying from 10 to 25c., frequent inquiries are received as to the possibility of marketing antimony ores. Heretofore, and in fact at present, a large proportion of the ten thousand tons or so of antimony used annually in the United States, has been imported from China, with smaller amounts from Germany and England. Floods and revolution have interfered with Chinese production to such an extent that, coupled with a good demand, prices have risen markedly above the 7 or 8c. level that obtained before the World War.

Several potential producers of antimony ores have appeared on the scene in North America, chiefly in Mexico. They are anxious to find buyers for their product but unfortunately no antimony smelters seem to have been established on this continent, though some recovery of antimony has been made in the fume from lead smelters. Antimony ores are admitted free, whereas the metal is subjected to a 2c. duty, so it would seem, with present market conditions, that a smelter in the United States might be a paying proposition. The Chinese smelters are of course, not favorably situated for North American producers, who must perforce ship their product to one of the English or Continental reduction works.

To those who are thinking of shipping antimony ore, it might be said that either sulphide or oxide ores are acceptable, though the former are generally preferred. The antimony content should be at least 50 per cent, and preferably 60 per cent or more, which might be obtained at some mines by concentration. Zinc and bismuth are very objectionable impurities; lead, copper, and arsenic somewhat less so, though penalized.

Passing of Old Mines

GOOD MINES do pass, regrettable though it be. Often when the end is in sight, the directors of the enterprise seek to perpetuate their business by acquiring another property, utilizing accumulated funds for this purpose. Sometimes they are successful in their quest, but when they are not the inevitable liquidation ensues. Nevertheless the cleaning up of what was once a good mine takes an appreciable time as is instanced by both the Tonopah Mining Co. with its Tonopah mines and the Tonopah Belmont mine in Nevada. Another instance is afforded by the Great Boulder Proprietary mine in Western Australia. Organized in 1894, it first paid a dividend in 1895 and thereafter every year until 1924.

From 1903 to 1917, inclusive, it paid £262,500 per year, the total being £6,042,216 from net profits of £7,495,001. Profits began to dwindle in 1922 and in 1925 were only £2,244. Ore reserves by the end of 1925 were less than a year's ore supply. Although the end of this property appears to be in sight, a remote chance remains that new orebodies may be found.

Characteristic of an experienced operating staff is the thoroughness with which the final working over of the property has been accomplished and the maximum amount of metal won. Necessarily, ordinary profits can not be sustained and such work may easily result in an operating loss. This difficulty is often recognized and met by turning the property over to leasers.

Beneficent Price Control

ONE IS ACCUSTOMED to associate monopolies, price control policies, and tariff protection with high prices to the consumer. That this does not always follow is exemplified by another reduction in the prices of Mazda incandescent lamp bulbs, amounting to about 5 per cent, this being the eighth reduction in price that has been made in the last six years. Though commodity prices in general are about 65 per cent above what they were in 1914, Mazda lamp prices are 44 per cent below what they were at that time, and the quality, furthermore, has been considerably improved. The ordinary 40-watt bulb now sells to the ultimate consumer in New York City for the small sum of 27c., certainly a reasonable price in view of its utility and the large amount of scientific study that has preceded its manufacture. Though no one manufacturer has the exclusive right to make these lamps, the patents are controlled by the principal electric companies who cooperatively support the research necessary to improve the lamps and reduce manufacturing costs. Their sale is closely regulated and one rarely finds any cutting of prices.

Petroleum in Albania

Where Indications of Oil Have Been Noted and What Steps to Develop an Industry Have Been Taken to Date—General Geology of Country as Described by Recent Italian, French and German Writers—Bibliography

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Arthur H. Redfield

ALBANIA is at the same time one of the newest and one of the oldest of oil lands. Indications of the presence of petroleum have been known for untold centuries. Many ancient writers, including Aristotle, Aelian, Dion Cassius, Pliny, Strabo, and Vitruvius have described the "eternal fires," fed by natural gas, which were adored by the ancient Illyrians, and have referred to the occurrence of viscid bitumen. During the waves of barbarian invasions which characterized the Dark Ages, during the Crusades and the medieval wars of the Byzantine Empire with Slavs and Turks, and still more during the five centuries of Turkish dominion, nearly all knowledge of this remote corner of the Balkan Peninsula was lost, and Albania remained largely an unknown country.

Although a few scientific travelers in the first half of the nineteenth century, notably Ponqueville, Virlet, Boué, Viquesnel, and Von Hahn, had published reports of their travels and observations, information on the geology of Albania was fragmentary and incomplete. In 1868 Coquand described the asphalt mine of Selenitsa, the oil and gas seepages near by, and the geologic relations of the occurrences. In 1893 Simonelli described the fossils in the Pliocene sand of Selenitsa. A more thoroughgoing study of the Selenitsa deposit was made by Martelli in 1905. Between 1905 and 1915 Nopcsa worked out the geology of the northern third of Albania, and 1912 Martelli published a study of the Acroceraunian Peninsula.

World War Caused Study of Resources

The outbreak of the World War found the central and southern two-thirds of Albania almost entirely unknown; the studies made by Dal Piaz, De Toni, and Almagia in 1913 did not come into print until 1915. The exigencies of the war caused Albania to be occupied by various armies, the Italians in the Valona district, the French in the Koritsa district of the southeast, and the Germans, Austrians, and Bulgarians in the north and center of the country. The attention of all three armies was drawn to the oil seepages and to the natural resources of the country; and geologic studies were made by geologists of three nations. In the southwest Captain Frederico Plate surveyed for the Italians the district around Valona. In the southeast Bourcart made a similar study for the French. For the Austrians Nowack was the leading spirit, seconded by Hauer, Welter, and Goebel.

With the return of peace, the studies begun during the war were continued and enlarged, especially by the indefatigable Nowack and by Bourcart. As official geologist to the Albanian Government, Nowack has published a series of detailed studies of several districts. Both Nowack and Bourcart have summarized their own studies and those of others into general descriptions of the country. As a result of these studies and those of other geologists whom space will not permit naming, a fair picture of the geology of Albania can now be had. Upon the studies of these geologists the present review is based.

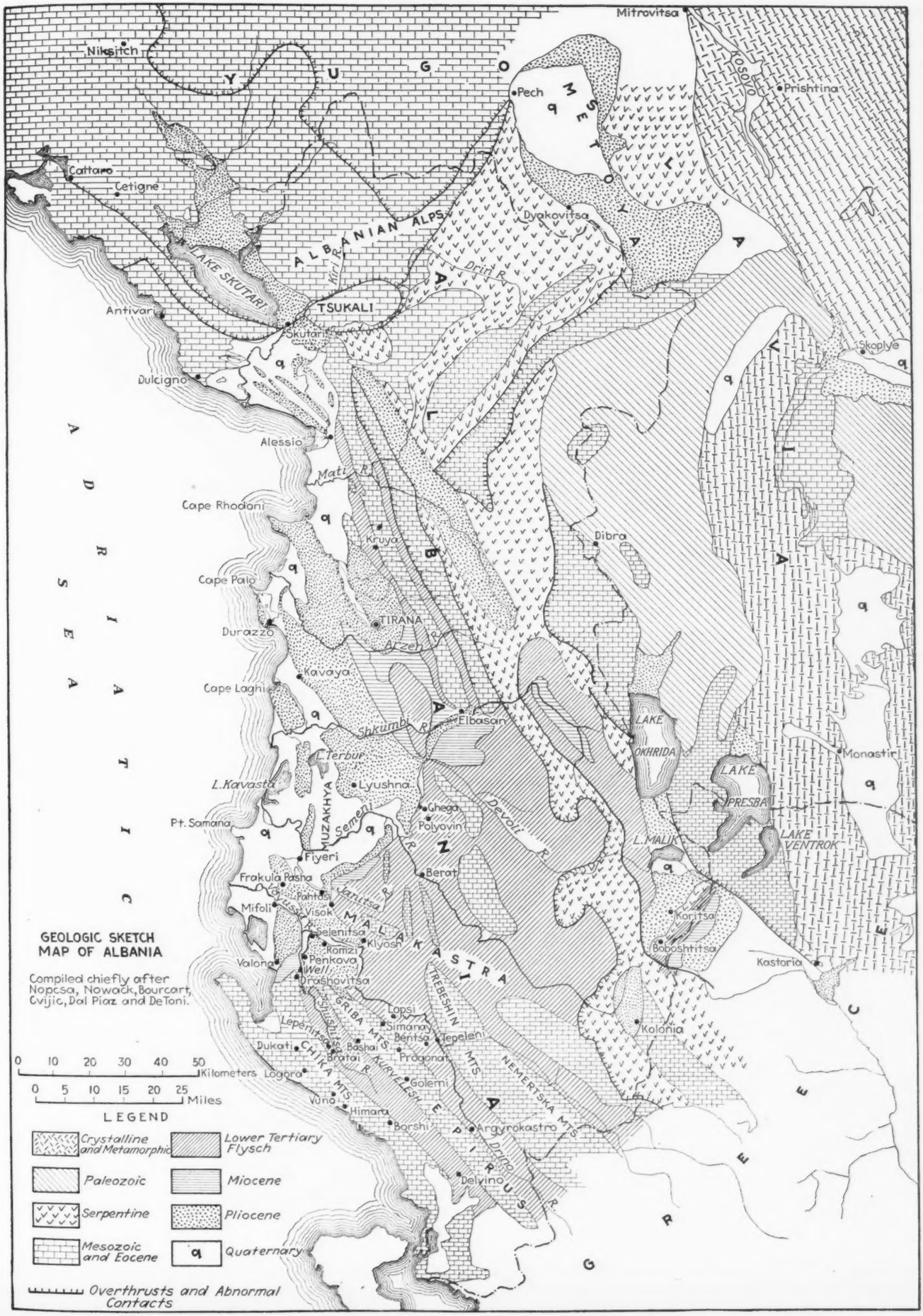
Albania a Transition Area

Albania forms both in topography[1] and in structure a transition area between western Yugoslavia and western Greece. In eastern or Inner Albania the folded, faulted, and intruded Mesozoic and Paleozoic strata of the Dinaric Alps of western Yugoslavia are continued southeastward into Greece. In southern and western Albania the younger folded Cretaceous and Tertiary beds of Grecian Epirus are continued northwestward to plunge beneath a Quaternary plain and die out in the capes which project into the Adriatic Sea.

The geology of northern Albania is known chiefly from the researches of Nopcsa. In the extreme north of Albania, a partly range-like, partly plateau-like continuation of the Dinaric Alps of Bosnia, Herzegovina, and Montenegro, curved to the northeast, extends from Lake Skutari to the downfaulted depressions of the Metoya and of the Kosovo Polye in the west of Old Serbia. This mountain range, known as the Albanian Alps, is formed of steeply tilted Triassic and Cretaceous limestone and dolomite which rest upon Lower Triassic shale and sandstone and the underlying Paleozoic slate, and are overlain by an Upper Cretaceous formation of the type known in the Alps and Carpathians as "Flysch," consisting of coarse sandstone and shale, which is interbedded with thick serpentine intercalations. The rocks are intersected by numerous faults, between which subsidences have occurred. They are in part at least overthrust on the Jurassic beds of the Tsukali range to the south.

South of the Alps of northern Albania between Kiri and Drin rivers rises the Tsukali, a short range of Mesozoic and Eocene rocks folded and overturned to the south-southwest. These are overthrust on the north and west by the comparatively unfolded but more rigid rocks of the north Albanian ranges. The zone of over-

[1]The topography of Albania is illustrated by both contourlines and hypsometric shading on the Sofiya sheet of the International Millionth Map of Europe, London, 1918. On the large and detailed Carta Corografica dell' Albania e delle Regioni Contermini del Montenegro, Serbia, e Grecia, 1: 400,000, by A. Dardano, published at Novara, 1916, relief is indicated by shading.


Mitrovitsa
Niksitch
YUGOSLAVIA
Pech
Kosovo
Prishtina
Cattaro
Cetigne
ALBANIAN ALPS
Dyakovitsa
LAKE SKUTARI
Drin R.
TSUKALI
Antivari
Skutari
Skoplye
Dulcigno
ALBANIA
Alessio
Mati R.
Cape Rhodoni
Kruya
Dibra
Cape Palo
TIRANA
Durazzo
Arzen R.
Kavaya
Cape Laghi
Elbasan
Shkumbi R.
LAKE OKHRIDA
Monastir
L. Terbur
L. Kavasta
Lyushna
LAKE PRESBA
Ghega
Devoli R.
Pt. Somana
Semeni R.
Polyovin
L. MALIK
LAKE VENTROK
Fiyeri
Berat
Frakula Pasha
Vojussa R.
Mifoli
Visok
Selenitsa
Klyosh
Romzi
Penkova
Valona
Well
Drashovitsa
Koritsa
Boboshtitsa
Kastoria
Lepenitsa
Dukati
Bashai
Bratai
Logoro
Lopsi
Simanay
Beritsa
Tepelen
Progonat
Kolonia
Golemi
Vuno
Himara
Borshi
Argyrokastro
Delvino
GREECE
GEOLOGIC SKETCH MAP OF ALBANIA
Compiled chiefly after Nopcsa, Nowack, Bourcart, Cvijic, Dal Piaz and DeToni.
0 10 20 30 40 50 Kilometers
0 5 10 15 20 25 Miles
LEGEND
Crystalline and Metamorphic
Lower Tertiary Flysch
Paleozoic
Miocene
Serpentine
Pliocene
Mesozoic and Eocene
q Quaternary
Overthrusts and Abnormal Contacts

turned folding represented by the Tsukali range may be traced northwestward along the foot of the Zagora Platform to Kotor (Cattaro) Bay, and southeastward along the foot of the Inner Albanian ranges into northern Greece.

Western Albania Low Mountains and Plains

Western or Lower Albania consists of a strip of hills and low mountains with intervening plains lying between the coast and the Inner Albanian Mountains, and extending southward from Dulcigno with gradually increasing breadth to Semeni River. South of Semeni River the hills and low ridges give way to a region of higher relief, known as the Malakastra, which in turn passes into the mountain ranges of Epirus.

Lower Albania is built chiefly of Tertiary beds of all stages from the Eocene to the Pliocene, which in places merges into the Pleistocene. The chief rocks are slightly consolidated sandstone and conglomerate, and clay and marl of marine and brackish-water origin. Nummulitic limestone of probable Upper Cretaceous to lower Tertiary age occurs only in the south, where it is brought to the surface by anticlinal uplifts. The Eocene, Oligocene, and lower Miocene consists of a regular alternation of thin bands of calcareous sandstone with hardened marl and clay of the type known in the Alps and Carpathians as "Flysch." In the middle Miocene soft sandstone, conglomerate, marly and clayey beds and in the uppermost Miocene thin beds of lignite occur. The Pliocene consists of marly clay and marly and clayey sandstone.

Much Folding in Tertiary of Lower Albania

Everywhere the Tertiary beds of Lower Albania are folded, fractured, and in the extreme east, overthrust. The folding began in the middle of the Miocene and continued into the Quaternary. The folds represent the structural continuation of the Oligocene folds which produced the mountain chains of southern Albania and Grecian Epirus, and the folding may be regarded as a continuation in the later Tertiary of the same process of folding. Accordingly in the cores of the anticlines to the south progressively older rocks are exposed. Broadly speaking, the structure is characterized by three great anticlinal uplifts with intervening synclines. The low ridges formed by the anticlines trend from north-northwest to south-southeast, and meet in an acute angle the shore of the Adriatic, forming promontories on their seaward ends—Capes Rodoni, Pala, Laghi—between which the shore retires in flat, marshy bays. Between the ridges wide plains, corresponding to the synclines, extend inland from the bays—the Ishmi plain and the plains of Kavaya and Muzakhya.

The Malakastra

South of Lower Albania, the Malakastra comprehends the rugged country which extends from the Semeni southward to the Voyussa River and from Ossum River westward almost to the Adriatic Sea. It forms a transition area from Lower Albania to the mountain regions of southern Albania and Grecian Epirus. Like Lower Albania, the Malakastra is underlain by Tertiary deposits except in the anticlines of the eastern Malakastra where Cretaceous strata outcrop.

In the westernmost Malakastra the marly and fossiliferous sand, conglomerate, and clay of the Pliocene are folded into flat domes, whose axes strike from northwest to southeast. Toward the interior the intensity of the folding increases; the beds are steeply inclined and extensively fractured; in places older strata have been overthrust upon younger strata. Toward the east the folding begins to assume more of a north and south direction, and the middle and upper Miocene resistant limestones form well-marked ridge lines. The eastern Malakastra is composed in the main of four great anticlines of Cretaceous to Eocene limestone running parallel from south to north with lower Tertiary Flysch in the intervening synclines. In these formations the beds are intensely crumpled and plicated in detail. The two eastermost of these anticlines are continued directly in the folded chains of Epirus.

The faults run chiefly along the strike of the folds, and are for the most part overthrusts which have developed from ruptures in the limbs of the folds and crests of the anticlines. Three great strike faults in particular continue southward beyond Valona, and are properly reflections of pre-existing faults from the older folded Epirote Mountains. In southeastern Malakastra appears an upper Tertiary basin the eastern part of which has been overthrust by lower Tertiary Flysch. This line of faulting has been traced northward for a distance of 18 miles, and it probably continues southward into the Voyussa valley.

Epirote Ranges of Complicated Structure

The Epirote ridges which extend from Voyussa River south-southeastward to the Greek frontier are composed of Mesozoic and lower Tertiary formations. Because of the extremely complicated structure, the relatively small content of fossils, and the difficulty of access to this mountainous territory the geology is not especially well known. In general, the Mesozoic succession (lower Triassic to Upper Cretaceous) is formed of a limestone-chert-dolomite complex practically uninterrupted by any other kind of rock. This is followed by Cretaceous-Eocene nummulitic and rudistid limestone, and this in turn by Eocene and Oligocene Flysch, consisting chiefly of sandstone, marl, and shale. These strata do not succeed one another anywhere in regular order. Great faults break them up; and on the other hand gaps in the succession occurred when the beds were originally laid down over irregular areas.

The basis of the structure is folding; this has been modified, however, by ruptures, overthrusts, and normal faults. The three principal mountain ranges, the Chika, Griba, and Trebeshin-Nemertska, are anticlines ruptured along their crests, showing cores of Mesozoic limestone overthrust upon younger beds. Between these anticlinal ranges are synclinal valleys filled with intensely folded lower Tertiary Flysch.

Inner Albanian Ranges of the Dinaric System

The eastern half of Albania consists of the Inner Albanian ranges, a part of the Dinaric mountain system. These are composed in the east of Paleozoic shale and sandstone, Triassic shale, and Jurassic and Cretaceous limestone and in the west of Mesozoic and lower Tertiary strata involved in complicated folds and piled up in great overthrust masses. The Mesozoic consists largely of basic igneous rocks more or less altered to serpentine, as well as of shale, limestone, and pure flint beds. Unconformably over the Mesozoic serpentine for-

mation lie great masses of Upper Cretaceous limestone. The Flysch formation in Inner Albania occurs only on the western margin of the mountains, where it is overthrust by a great mass of the Mesozoic serpentine formation. On the extreme western border of Inner Albania, Cretaceous-Eocene nummulitic limestone is brought to the surface by a sharply folded anticline, somewhat overturned to the west, the so-called "Wall of Kruya."

Koritsa Basin

In southeastern Albania the Inner Albanian ranges are interrupted by the plain of Koritsa. This is typical down-faulted basin, a continuation of the zone of down-faulting marked by the Okhrida and Presba basins and the Metoya. In the Koritsa basin a block of the Mesozoic serpentine formation of Inner Albania, 5 miles wide, was let down during the middle and upper Tertiary and early Quaternary. The basin is accordingly filled with thick upper Tertiary beds, largely buried beneath Pleistocene deposits. The Tertiary beds consist of Oligocene conglomerate and breccia, followed by alternating sand and clay with lignite coal-seams; lower and middle Miocene thick marl, shale, and sandstone of Flysch-like character, with a few intercalated beds of *Lithothamnia* limestone; upper Miocene thick sandstone and conglomerate and lignite seams; and loose or poorly consolidated sand and pebble beds, probably of lower Pliocene age. The Tertiary beds dip in general flatly to the east or northeast; on the eastern margin, however, they dip to the west toward the center of the basin.

Indications of Oil and Gas Numerous

The presence of petroleum and natural gas in Albania is suggested by numerous seepages of oil and asphalt and emanations of inflammable gas. These are most abundant in western Albania, in the Tertiary and Mesozoic beds of Lower Albania, of the Malakastra, and of the Epirote ranges.

In Lower Albania signs of oil and gas are not as numerous as in the more highly disturbed regions to the south. Near Lyushna iridescent films occur at times on a spring smelling strongly of sulphur. North of Berat upon the left side of the Devol valley a line of oil seepages runs north-south through Kutsova, Polyovin, and Ghega. Occasional seepages of oil in the winter are reported to occur near Tirana and near Durazzo. These have not, however, been authenticated.

Signs of hydrocarbons are more numerous in the Malakastra to the south. In the territory between Pahtos and Visok, on both sides of the Janitsa valley, for an area of 1 to 1½ sq.mi., asphalt oozes from an upper Miocene oyster-bearing sandstone faulted down against the older Flysch. Iridescent films occur on sulphurous springs which issue in this territory in various places. The asphalt impregnations may extend, even though less rich, for a wider area also; a calcareous conglomerate strongly impregnated with bitumen was found recently in the Flysch area, near the Voyussa. Finally at the foot of Mount Likovun, toward the Voyussa plain near Frakula Pasha, oil seeps from upper Pliocene marly-sandy strata in a stream bed, visible at least in winter. The bitumen springs and the "perpetual fire" of ignited natural gas were known here in antiquity.

Asphalt deposits occurring at Selenitsa on the Voyussa have been mined since the days of Roman rule. The asphalt occurs also in veins and dikes in both the overlying and the underlying beds. It forms also in the overlying upper Pliocene sand and conglomerate beds still smaller layers, stringers, and veins, as well as rich impregnations, especially near Resulani, about a mile east of Selenitsa. In this way the asphalt occurrences extend two to two and a half miles around Selenitsa.

Coquand assumed that the asphalt was altered petroleum, and originated in the beds in which it occurs. Martelli and Nowack believe, however, that the asphalt is of secondary origin; that the great asphalt masses on the upper limit of the lower Pliocene marl are fossil asphalt lakes, which accumulated on the lagoon-like flat Pliocene coast and were fed by bitumen springs from below. The bitumen which arose in the form of viscous asphaltic oil, passing through the fissures, bedding planes, and joints on its way to the surface, has sent off in the underlying beds also smaller deposits and offshoots, and here just as on the surface has been oxidized to solid asphalt. In the overlying upper Pliocene sand and conglomerate beds the bitumen is supposed to be due partly to migration from the great asphalt masses in the lower Pliocene and partly to the rising of bitumen which has continued down to the present time and has saturated these younger beds. Many phenomena, according to Nowack, appear to indicate that the bitumen oozed out while the lower Pliocene beds were being laid down, and the viscid asphaltic oil spread over the sand and pebble beds, which at times were dry. The occurrences at Selenitsa and Pahtos-Visok manifestly follow the great western fault line of the Malakastra. Such a line of disturbance offers naturally to the accumulated and inclosed hydrocarbons the most favorable circumstances for escape to the earth's surface.

Oil Seepages and Mud Volcanoes

Viscous oil in all stages of transition to asphalt is known to occur in small quantities in the asphalt-bearing beds of Selenitsa, especially in the hollow shells of mollusks. Oil occurs in greater quantities, however, about two miles east of Selenitsa on the bank of the Voyussa near Papaz in connection with "mud volcanoes." Several seepages occur upon the flat sand and gravel shore of the river in an area of about 1,000 square meters. A dark and viscid oil is erupted at short intervals, together with gas and hot water. Around about the places of eruption are formed low crater walls cemented by asphaltic masses. The monthly seepage of oil is estimated at an average of 2,500 kg. (18.75 bbl.).

Along with the gas which occurs in the mud volcanoes emanations of methane mixed with sulphurous gases may be observed about 1 km. (0.62 mile) to the south in the hill-land near Romzi, which burn most of the time. The burning gas issues without a perceptible sound from the crevices and joints of a Flysch-like rock consisting of shale, marly shale, and foraminiferous calcareous sandstone beds (upper Flysch?).

The signs of hydrocarbons of Selenitsa may be traced in a southeasterly direction past the Maya Madhe and Madja Aderai, in many places in the form of bituminous impregnations of the sandstone, coarse conglomerate, and limestone (lower Tertiary Flysch).

An area of abundant indications of oil and gas is the valley of Shushitsa River, especially between the Drashovitsa and Penkova bridges. Numerous springs issue at the eastern foot of the Chika Range, which brings up especially in the rainy season or in times of flood numerous drops of oil. In the very rainy winter of 1916-17, when the Shushitsa plain was flooded, an iridescent scum of oil floated upon the stagnant water. The daily output of these springs was estimated by Plate at 300 liters (1.89 bbl.).

According to the Roman geographers Strabo and Pliny, the asphalt of the Illyrian or Albanian coastal region was mined in ancient times and employed to safeguard the vines against insects and to preserve wooden ships from decay.

At Selenitsa it was mined before the World War by a French company, the Société Anonyme des Mines de Selenitza, which produced more than 7,000 metric tons of bitumen annually. The world-famed boulevards of Paris have been largely paved with Selenitsa asphalt. Since the war, the mining of the bituminous rock was resumed by an Italian company, the Societá delle Miniere di Selenizza, which had acquired the concession of the French company in 1919.

In both the Chika and the Griba ranges of Albania Epirus bituminous limestone, marl, and dolomite are widespread. Marly bituminous limestone of lower Eocene age outcrops along the eastern slope of the Maya Stogo between Lepenitsa and Bratai. Dark, sandy upper Triassic dolomite, alternating with lustrous coal seams and light-colored beds of chert, is exposed near Dukati, and extends along the whole western slope of the Chika Mountains from the Logora Pass to the district of Himara. Near Palas, between Logora Pass and Himara drops of oil are carried on the mountain streams, and in their beds are found pebbles and boulders whose crevices and cracks are filled with a tar-like black substance. Between Vuno and Himara on the slopes of the Mai e Mleses are found a few pieces of dolomite with small inclusions of asphalt. Southeast of Himara, on the south side of the valley of Borshi very strongly bituminous limestone beds with black chert are exposed; here a little prospecting was done by the Italians during the occupation. In a stream which flows along the contact between Mesozoic bituminous limestone and the Flysch upon which it is probably overthrust, the limestone is saturated with dark viscous bitumen; evidently under the cover of débris lies an oil seepage.

A second zone of hydrocarbons extends along the Griba range and the limestone plateau of Kurvelesh; along the Mashari-Simanay-Lopsi-Tepeleni road viscid bitumen issues in places from Mesozoic limestone. Likewise, in the Bentsa valley on the east slope of the Griba range hydrocarbons are said to seep out. On the western side of the Maya Tartarit near Bashai, Commune of Smoktina, in the steep gorge of the Smoktines River viscid asphalt-like bitumen exudes abundantly from the limestone near its contact with the Flysch formation.

On the western slope of the Kurvelesh plateau not far from the village of Golemi asphalt oozes abundantly for several hundred yards along the joint planes and bedding planes of a chert-bearing limestone (Upper Cretaceous?), so that the rock in places appears to be a breccia cemented by asphalt. A spring with oil showings is reported to occur on the north slope of the same mountain near Progonat. Signs are reported near Delvin.

In southeastern Albania indications of oil and gas occur in the Koritsa basin. At the springs of Belovoda, about nine miles southwest of Koritsa, along the contact between the serpentine limestone basal complex and the Tertiary, numerous salty springs rich in inflammable gas issue from a perpendicular fissure in the serpentine striking east-northeast—west-southwest. No iridescent film or oil spots are to be observed, however. On the opposite or eastern fault-margin, about six miles south of Koritsa, east of Boboshtitsa, gas bubbles rise at short intervals in a little pool with an iridescent, greasy surface fed by a clear spring. Numerous sulphur springs issue from the Flysch-like Tertiary, especially around the margins of the downfaulted basin. It has been suggested by Nowack that all these sulphur phenomena may be traced to the reducing effect of bitumen on the gypsum-bearing water.

TWO-THIRDS of Albania was practically unknown when the World War began. Occupation of the country by various foreign armies led directly to the study of its resources by French, Italian, and German engineers. Indications of petroleum and natural gas were numerous, but no prospecting had been done. After the armistice, keen international competition for petroleum followed. Six concessions were granted in 1925 to foreign companies, one of which—the Anglo-Persian Oil Co.—began drilling last October.

Possibilities of Each Structural Province

The petroleum possibilities of Albania may be roughly appraised according to the structural divisions of the country. Little hope may be entertained of the tilted, faulted, and overthrust limestone and slate of the Albanian Alps, or of the overturned folds of the Tsukali range. Likewise, the Paleozoic and Mesozoic rocks of Inner Albania are in general too highly disturbed, and the Mesozoic in particular contains too many interbedded igneous rocks, to offer any great prospects of oil or gas in commercial quantities. Possibilities of oil and gas in Albania appear to be confined to the younger and more moderately folded Tertiary and upper Mesozoic beds of the Epirote ranges and the Malakastra and the upper Tertiary of Lower Albania.

In general, the flat dome-shaped folds of the Lower Albania, such as the hill range, which rises like an island above the Muzakhya Plain, offer favorable geologic conditions for the accumulation of oil and gas. As Nowack points out, the bodies of the anticlines have not been deeply eroded; the thick Pliocene clay forms an intact cover over the Miocene and lower formations which are more favorable to the accumulation of hydrocarbons. That the succession of beds is rich in hydrocarbons is indicated by the long-lived and rich seepages of bitumen near Selenitsa. As source beds, several formations rich in foraminifera occur in the upper Tertiary and in the lower Tertiary Flysch, and the Mesozoic limestone exposed in the Epirote Ranges is saturated with bitumen. Sandstone beds, suitable for reservoirs, are interbedded with impervious marl and clay in both the Flysch and the upper Tertiary.

Although the Epirote are rich in indications of oil and

asphalt, they are not regarded by Nowack as an especially favorable area for drilling. The anticlines are ruptured by deep faults, overthrust and deeply eroded in their cores. In the Mesozoic limestone complex which is exposed in the anticlines, porous rocks which might serve as reservoirs of oil are generally lacking. The bitumen is too diffusely distributed in the limestone and dolomite, and even the local accumulations of asphaltic oil and asphalt in fissures, joints, and cavities are too slight, to assure commercial production.

On the contrary, as Nowack points out, the numerous indications of oil and bituminous rocks of southern Albania are of great theoretical interest, as they indicate the presence of hydrocarbons even in the lowest Mesozoic formations. In Lower Albania where they dip beneath the folded Tertiary they may be regarded as a possible primary source of oil.

In southeastern Albania the Tertiary beds of the Koritsa Basin which contain the indications of oil and gas are buried beneath a thick cover of Pleistocene alluvium. The beds are affected chiefly by faulting; broad folds such as characterize Lower Albania are few or absent. Beyond this, little is known of the structure. Accordingly, little can be determined in advance of the oil possibilities of the Koritsa basin.

Little Prospecting for Oil Hitherto

Albania can scarcely be said to have been tested for oil and gas. Until the last twelve months only one well is known to have been put down in the entire country. During the World War, while Valona was occupied by Italian troops, the attention of the Italian Ministry of the Marine was called to the abundant oil seepages in the plain of Sherishet on the left bank of Shushitsa River between the Penkova and Drashovitsa bridges.

In September, 1917, the Ministry of the Marine sent a commission of geologists and petroleum technicians. A drilling site was chosen north of Drashovitsa in the plain of Sherishet on an anticline which marks the dying-out of the Chika upfold. A light railway was built to the site and drilling was begun early in 1918 under the auspices of the Italian Navy by a modified Canadian rig with a wire cable, driven by a lean-gas motor of 30 hp. Such rigs, used in the Italian oil fields near Piacenza, can drill to a depth of 1,000 meters (3,280 ft.). Tool shops, a forge, a laboratory, shops, sheds, a commissary, and bunk houses for the workers were set up, and a regular oil camp sprang into being.

Oil Struck at 333 Ft. in Drashovitsa Field

Drilling in the Drashovitsa field was frequently disturbed by air raids from the Germans and Austrians. The hole was put down to a depth of 200 meters (656 ft.). It passed through chiefly marl and limestone with comparatively little sandy clay, belonging to the Pliocene, according to Plate; or to the lower Tertiary or lower Miocene Flysch, according to Nowack. Showings of oil occurred in limestone beds at depths of 71.6 meters (235 ft.); 84.7 meters (278 ft.); 91 meters (299 ft.); 101.6 meters (333 ft.); 119.5 meters (392 ft.); 121.5 meters (399 ft.); 168 meters (551 ft.); and 178 meters (584 ft.). The showing at 101.6 meters (333 ft.) yielded 3,500 liters (22 bbl.) in 24 hours. Altogether 80 metric tons (600 bbl.) of thick, blackish crude oil with a specific gravity of 0.934 (20 deg. A.P.I.), fairly fluorescent and with a characteristic bituminous odor, was taken from the well. According to Maddalena, it gave off the fractions on distillation shown in the accompanying table:

Products of Distillation of Drashovitsa Oil

Fractions		Per Cent
0°—150°C.	Light oils	2.10
150°—310°C.	Kerosene	17.20
Above 310°C.	Residuum and loss	67.93
	Coke (dry)	11.00
	Sulphur	1.77
		100.00
Flash-point (Abel-Pensky)		125°C
Heat value, calories		9,133

When war broke out in April, 1920, between the Italians and Albanians, drilling was suspended, and when the Italians evacuated Valona in the autumn of 1920, work on the oil field was abandoned. The equipment was later wrecked by the Albanians, and the oil camp is today in ruins.

Keen Competition Following War

At the close of the World War, in the keen international competition for oil which followed, Albania was prospected by geologists of the Anglo-Persian Oil Co., Ltd., of London; the Standard Oil Co. of New Jersey; and the Sinclair Consolidated Oil Corporation, of New York. All three companies sought concessions from the Albanian Government; the Sinclair, however, later withdrew. An agreement in 1921 gave the Anglo-Persian exclusive prospecting rights over all Albania; this was modified in 1923, and a much smaller area was finally granted.

The first concessions granted by the Albanian Government were ratified in 1925. Not fewer than six concessions were granted in that year, all generally similar in their provisions. All run for sixty years and can be relinquished only on a certificate by the Technical Commission that there is no oil or that the oil cannot be profitably developed. All require a definite amount of drilling to be done in the first eight years. All specify a royalty of 13½ per cent of production and an annual ground rent of 1½ gold francs per hectare ($0.117 per acre).

The first of these concessions was granted on Feb. 18, 1925, to the Anglo-Persian Oil Co., Ltd. By its terms the company was permitted to prospect and examine 200,000 hectares (494,000 acres) of land located in not more than four separate zones, and to select for exploitation by April 30, 1925, not more than 50,000 hectares (123,500 acres). Specifically excluded from the concession are the area about Drashovitsa drilled by the Italians during the war, bounded on the north by a line from Risilia to Lubenya, on the east by a line through Lubenya and Penkova to Peshkopiya, on the south by a line through Peshkopiya and the Serishta Bridge to Kishbardha, and on the west by a line from Kishbardha to Risilia; and the Selenitsa asphalt concession. The concessionnaire must start drilling within three years, and must drill at least 1,500 meters (4,920 ft.) in the first year; 3,000 meters (9,840 ft.) in the second year; over 4,000 meters (13,120 ft.) a year in the third, fourth, and fifth years. Any excess drilling over the requirements may be credited to the following year. This drilling may be curtailed if the production should reach 25,000 tons (187,500 bbl.) per quarter-year. The concessionnaire shall have the sole right to develop the areas finally selected until Dec. 31, 1985. The concession may not be transferred without the

consent of the Albanian Government. The concessionnaire shall organize a subsidiary, known as the Anglo-Albanian Oil Co., Ltd., with a capital of £500,000, of which 40 per cent shall be reserved for Albanians. The concessionnaire must pay a royalty of 13½ per cent of all oil produced, either in cash or in kind, and a yearly ground rent of 1½ gold francs per hectare ($0.117 per acre). All drilling material and supplies may be imported duty free; there will be no export tax on petroleum or asphalt and no special taxes. The concessionnaire must supply the Albanian Government with petroleum, at 10 per cent below the market price, up to 20 per cent of the total output; no petroleum or asphalt may be exported until the requirements of Albania shall have been satisfied at the market price.

Up to January, 1926, the Anglo-Persian Co. had selected for development only 32,000 hectares (79,040 acres), lying in three tracts, one along the Adriatic coast between Kavaya and Lake Terbuf; a second comprising the area around Ardenitsa, north of Fiyeri; and a third area in the Malakastra. Drilling was begun on Oct. 17, 1925, on the Ardenitsa tract. At the end of 1925 the well had reached a depth of 300 meters (984 ft.).

A concession, generally similar in its provisions to that of the Anglo-Persian Co. was granted on March 12, 1925, to the Ferrovie dello Stato d'Italia (Italian State Railways). This grants rights of exploration over 50,000 hectares (123,500 acres) in not more than four separate zones, of which 30,000 hectares (74,100 acres) may be selected for development.

A conflict arose early in 1925 over the areas covered by the Anglo-Persian and the Italian State Railways concessions. The Italians claimed that the British concession amounted to a virtual monopoly of the possible oil lands, and urged in support of their claim for consideration priority of exploration and development, especially in the Drashovitsa well. The conflict was settled by an agreement between the Anglo-Persian and the Italian State Railways, whereby the two concessionnaires should exploit jointly 50,000 hectares (123,500 acres) in the English zone and 25,000 hectares (61,750 acres) in the Italian zone; and by an exchange of shares between the two companies. To the Italian Railways was allotted the 40 per cent of the stock of the Anglo-Albanian Oil Co., Ltd., which was reserved for Albanians, but which neither the Albanian Government nor private citizens had sufficient money to take up.

The areas finally selected by the Italian State Railways for development lie in three zones, one near Lyushna, in the Muzakhya Plain; the second in the district of Elbasan; and the third in the Malakastra adjoining the Anglo-Persian area on the south. At the end of 1925 a rig had been set up near Penkova, in the Shushitsa Valley, and preparations were being made to drill at Mifoli, on Voyussa River.

On May 7, 1925, the Societá delle Miniere di Selenizza, which held the concession to the asphalt mine at Selenitsa, had its concession extended to cover oil and enlarged to 2,300 hectares (5,681 acres). The concession extends from Selenitsa to the vicinity of Drashovitsa, where the Italian Navy drilled a well during the World War.

The fourth of these concessions, granted to the Standard Oil Co. of New Jersey, allows 80,000 hectares (197,600 acres) in not more than four different zones for exploration and 50,000 hectares (123,500 acres) for commercial development. The Standard Oil selected two zones for development, one of 47,000 hectares (116,090 acres) extending along the coast from Durazzo to Kavaya, and the second of 6,000 hectares (14,820 acres) along the coast from Lake Kavasta to Lake Arta.

Drilling equipment shipped in the fall of 1925 had reached Valona in January, 1926, and drilling was scheduled to begin in February.

A fifth concession, granted in 1925, is held by Mr. Henry Herbert Rushton, of London. It allows prospecting over 20,000 hectares (49,400 acres), and the selection of 10,000 hectares (24,700 acres) for drilling. Its boundaries have not yet been precisely defined.

The terms of the sixth and latest concession, granted to the Syndicat Franco-Albanais, of Paris, were published in the Albanian Official Gazette for Dec. 24 and 28, 1925. It allows 120,000 hectares (2,964,000 acres) for examination, and a choice of 30,000 hectares (741,000 acres) in not more than four separate zones, for drilling over a period of sixty years. The concessionnaire is obligated to drill at least 750 meters (2,460 ft.) during the first year of development; 1,500 meters (4,920 ft.) during the second year; and 2,000 meters (6,560 ft.) a year during the third, fourth, and fifth years, unless a yearly average production of 50,000 tons should be obtained, or an unusually large production should hinder the storage of the oil. The provisions relating to royalty, ground rent, tax exemptions, exports, and satisfying domestic requirements are similar to those in the Anglo-Persian contract. The Albanian Government has certain rights of participating financially in the enterprise.

[2]According to well-authenticated reports, the Anglo-Persian Oil Co. brought in on July 19, 1926, a 40-bbl. well near Patoz (Pahtos) in the Malakastra district, at a depth of 282.5 meters (926.8 ft.). This well is not to be confused with the first well at Ardenitsa, near Fiyeri, but is situated 14 km. (8.7 miles) southeast of Fiyeri. The oil is thick but of high grade. The well has been shut in until storage facilities can be completed.

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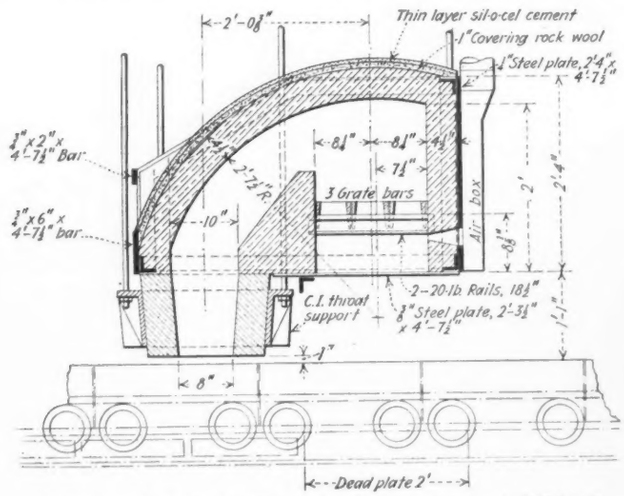
Feldspar mill of the Clinchfield Products Corporation, Erwin, Tenn.

Coke-burning Ignition Stoves for Sintering Machines

By Robert Wallace
Plant Superintendent, United States S. R. & M. Co., Midvale, Utah.

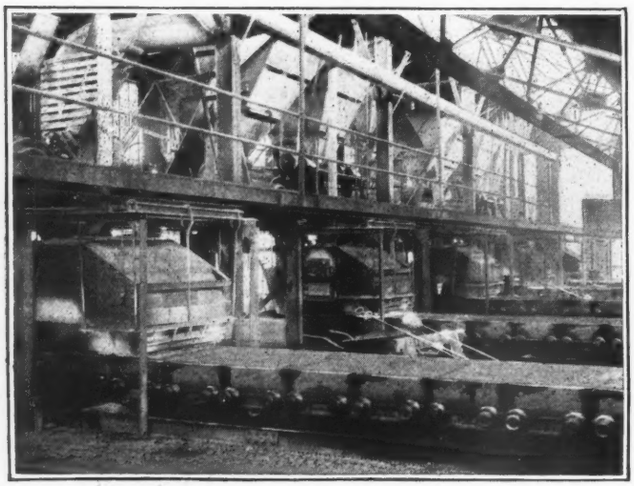
ONE OF THE PROBLEMS arisin , at the Midvale plant of the United States Smelting, Refining & Mining Co., in connection with the sintering of a great variety of mixtures, some of which sinter with considerable difficulty, has been to find a more efficient



Details of coke-burning ignition stove at Midvale

ignition device than the oil- or coal-dust-burning stoves heretofore used. There were two factors to be considered—efficiency of ignition and cost of operation. Mr. Somerset, of the Broken Hill Associated Smelters, Ltd., Port Pirie, Australia, upon the occasion of his recent visit to this country, called our attention to the superiority of the coke-burning stove over the other forms of ignition tried at the Port Pirie plant. This led to a trial of a coke stove on one of the Dwight-Lloyds in October, 1925, and the first stove so used proved so satisfactory that the five other sintering machines were equipped with coke stoves as rapidly as possible.

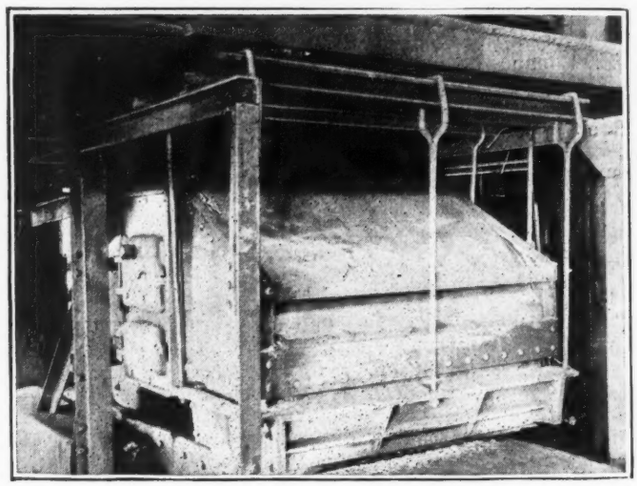
The Midvale stove was designed by F. M. Wichman, plant engineer, who had as a basis for his design plans



Dwight-Lloyd operating floor, showing five machines equipped with coke burners

of the Australian stove supplied by Mr. Somerset. It is worthy of note that both the Australian and Midvale stoves are similar to the stove introduced by F. D. Weeks at Salida many years ago. The device has now been around the world, starting as a coal burner in Colorado, then a wood burner in Spain, later a coke burner in Belgium and Australia, and finally has been introduced at Midvale, where the fuel used is coke breeze or screenings.

In construction the stove is quite simple. The shell is sheet steel open at the top, within which is built up a firebrick lining separated from the shell by a layer of sil-o-cel insulation. At one side and toward the bottom is the grate, which is separated from the throat by a low bridge wall. The roof of the stove is a firebrick arch, covered with an insulating layer of sil-o-cel cement. All of the interior of the firebrick lining and roof is covered with a coating of thermolith or carbofrax to render the surface more refractory. The stove is suspended by adjustable rods so that the throat is



Close view of one of the coke-burning ignition stoves

just forward of the dead plate of the sintering machine and with a clearance of 1 in. to 1½ in. between it and the surface of the charge.

Air for combustion is supplied by a fan under a pressure of 2 in. of water through a 5-in. pipe, connecting to the wind box at the back of the stove and fitted with a damper. Two fan-shaped tuyères connecting with the wind box distribute the air under the grate. Both the fire and ash doors are fitted tight to prevent leakage of air. A 2-in. layer of coke is maintained on the grate. The volume of air used is the theoretical quantity necessary to burn the coke plus 50 per cent excess. Temperatures of 1,600 to 2,000 deg. F. are readily secured.

A clear blue gas flame is drawn from the throat of the stove by the 12-in. suction on the wind box of the sintering machine deep down into the charge. Perfect and uniform ignition is secured. The surface of the charge is left porous, affording a free passage for the air, there being no tendency to fuse or blank off, as is sometimes the case when oil ignition is used; nor is the surface coated with carbon or ash, as may be the case when coal dust is used. The average consumption of coke breeze is 990 lb. per machine-day, and as this is a byproduct of the coke ovens, the coke-burning stove has not only proved to be more efficient for our conditions, but it costs less to operate than either oil or coal-dust ignition.

Proposed Ground Classification for Mining Purposes—II*

Slips and Faults Have Important Bearing on Quantity Production—Uniform Nomenclature and Standard Grading Assist in Arriving at Comparative Costs

By G. Townsend Harley
Morenci, Ariz.

THE OCCURRENCE OF SLIPS has much to do with the ease with which rock may be mined, and their classification is dependent entirely upon sight, aided by the five charts presented herewith, Figs. 4 to 8, which will serve as guides to limit the size of the rock pieces to be found within each classification.

4. *Occurrence of Slips*—For each class of ground as pictured in these illustrations, the true sum of the reciprocals of the mean diameters of the various pieces can be approximated in the following manner: The Tyler screen-scale ratios are extended into the larger sizes, above 1.05 in., by multiplying each size by 1.414 to obtain the next larger size. The diameter of the average piece passing through one opening and resting on the next smaller opening is the sum of these two openings divided by 2. The reciprocal of this number in each case is the figure desired. The reciprocal of the mean diameter of all the pieces making up the rock face is obtained by making the necessary assumption that each size falling between the limits given in the illustrations occurs in equal amounts; the sum of the reciprocals of each size, multiplied by the percentage of that size in the rock face, and divided by 100, will give the reciprocal of the diameter of the mean particle in the face. This is shown in Fig. 9.

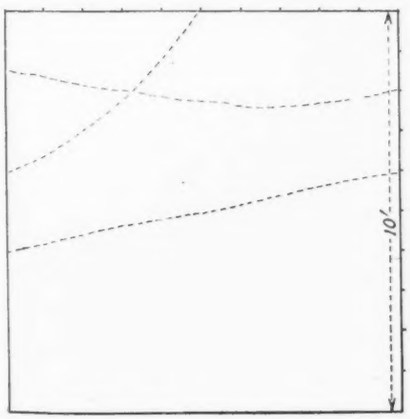
According to Rittinger, the work done in crushing is proportional to the surface exposed by the operation, or to the reciprocal of the diameter of the particles. From Fig. 9, then, it is easy to see why a breaking quality of ground based only on the number and position of the slips in the face is of no value for setting powder allowances. A little thought will make this clear. No matter how many fractures there may be in a rock face, if the rock is fresh and the fractures are tight the rock mass will nevertheless have to be broken by the explosive used in an amount almost equal to that of a solid face before the mass of rock can be dislodged from its position, as these solid pieces of rock are virtually keyed into place by one another. If the fractures are tight, but the surfaces of each rock particle are altered and somewhat softened, less powder is used, but still enough is needed to break up effectually these solid particles; and, lastly, if the fractures are open, or contain some gouge perhaps, and the rock pieces are well altered, a still smaller amount of powder will suffice, down to a theoretical minimum, which will serve merely to dislodge an already broken and loosened mass of small rock particles. Powder allowances, then, are based more on the degree of alteration of a rock face than on the number and placement of fractures and slips, and although the question of slips cannot be entirely eliminated, still a better basis for an exact powder allowance is the classification for the toughness of a rock (3) discussed in the first part of this article.

The classification is important, however, for other uses, particularly in ascertaining how much of an unsupported back may be maintained for long periods, the degree of air slaking and weathering that will go on in exposed rock faces, and the size to which rock in stopes will be comminuted by natural pressure.

Some Applications of the Data Obtained

During a detailed study of shoveling made in 1918 (*Trans. A.I.M.E.*, Vol. LXI) a chart, Fig. 10, was worked out, but not published at that time, showing the efficiency of shoveling when a proportion of the rock pile shoveled has to be first broken with a hammer. Generally speaking, any boulder larger than a 10-in. cube, or an 11-in. sphere, and weighing over 90 lb. will be broken with a hammer before it is put into a car; therefore, the ideal muck pile must contain no such pieces, if it is to be efficiently handled. In shrinkage stopes or caving stopes, or where mechanical shoveling methods are used, or where ore is dropped directly into

*Final. The first installment appeared in the issue of Sept. 4, 1926.



Occurrence of slips in rocks: Fig. 4—No fracture planes in evidence, or if present they are two to four feet apart and have usually been entirely recemented (Class I)

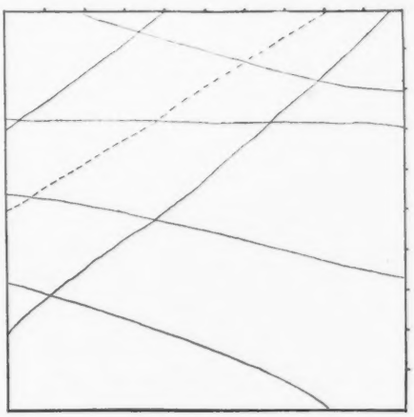


Fig. 5—Small fracture planes from one to three feet apart, containing little or no clay. Persistent slips in three planes make this gravel "blocky" (Class II)

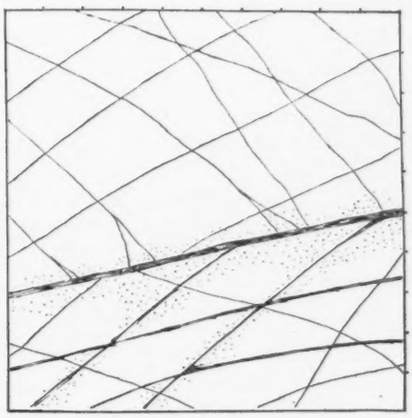
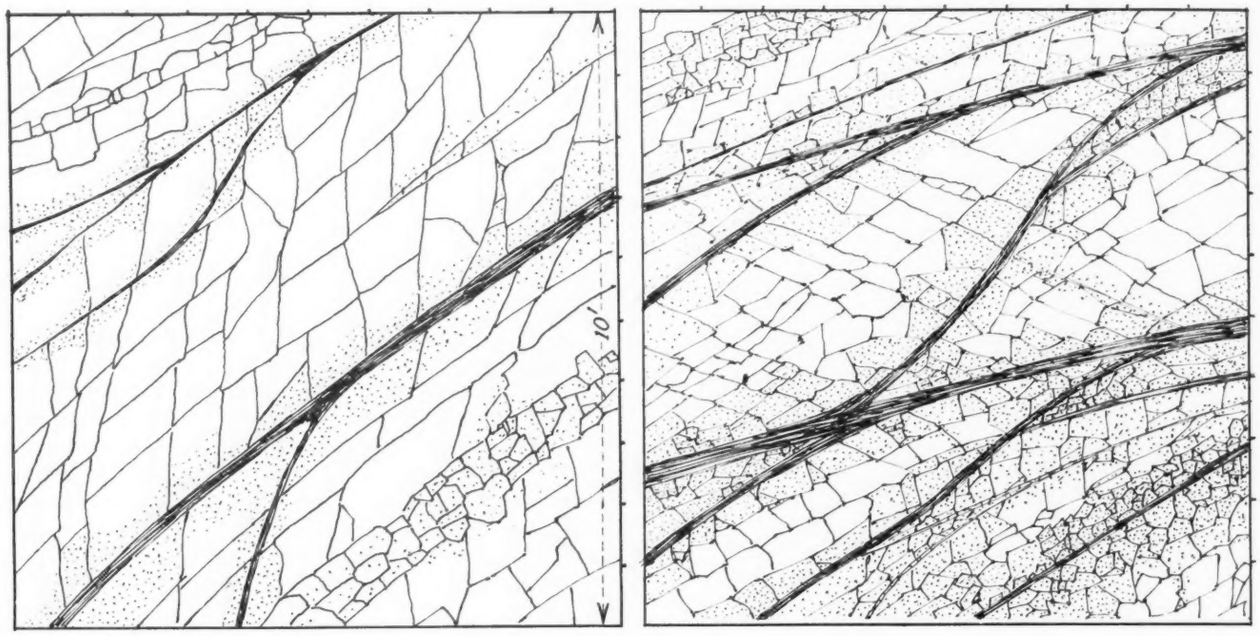


Fig. 6—Fracture planes varying from six inches to two feet apart. This ground is "blocky" when slips are in three planes, requiring less explosive to break (Class III)

chutes, a coarser muck pile is permissible up to the limits of grizzly openings, chute-door openings, car and skip capacities, and crushing-plant limits.

Considering for the present only the muck pile that must be shoveled, many complete screen analyses have been made on entire muck piles taken from drift faces, and it has been found that to keep the largest pieces of a size to pass through the opening, 11.88 in., the screen analyses must approximate that shown in the accompanying table.



Occurrence of slips in rocks: Fig. 7 (at left)—Fracture planes from three inches to one foot apart. There may be one or more wide slips filled with gouge. The smaller slips may be filled also with gouge. These slips make it easy to remove rock with pick (Class IV). Fig. 8 (at right)—Many fracture planes two to six inches apart, usually open or containing soft gouge. Rock of this class is thoroughly broken up (Class V)

It is now possible to define the "economic round" as the deepest round that can be drilled in a shift, containing a sufficient number of drill holes, so placed that the minimum powder allowance will break it to the ideal size for the muck pile, with the minimum of wasted energy and with the least shattering of the walls of the working place. The amount of rock broken should not be more than can be mucked out by a crew of muckers working one shift, in order to preserve the regularity of the cycle of operations. Stated as a cost problem, the "economic round" will give the greatest footage per man-shift of labor, with the lowest combined cost of drilling, breaking, mucking, and timbering.

The screen analyses of the rock drill cuttings and of the ideal muck pile will give an idea of the powder allowance for any face according to the following proportion:

$$\frac{\text{Power input of air drill per cu.in. of rock removed}}{\text{Effective work of explosives ft.-lb. per cu.in. broken}} = \frac{\text{Reciprocal of mean diameter of rock drill cuttings}}{\text{Reciprocal of mean diameter of pieces in the ideal muck pile}}$$

In this proportion, the reciprocal of the mean diameter of the pieces in the ideal muck pile should first be modified for the occurrence of slips in the face by deducting the proper reciprocal of the mean diameter (Fig. 9) and then for toughness, by multiplying the result by the index for toughness.

Example—The drill test shows a rock face to require 6,700 ft.-lb. of energy per cubic inch of hole drilled.

The screen analysis of the test-drill cuttings gives a reciprocal of the mean diameter of 184.445.

The reciprocal of the mean diameter of the ideal muck pile is 156.468.

The occurrence of slips in the face is as in Class IV, Fig. 7, giving a reciprocal of the mean diameter of 0.179.

The toughness of the rock has the rating 0.85.

X = the required effective work of explosives in foot-pounds of energy per cubic inch broken.

Then:

$$6{,}700 : X :: 184.445 : (156.468 - 0.179) \times 0.85$$

$X = 4.826$ ft.-lb. of effective energy per cubic inch to break the rock face to required size.

This figure, compared with the amount of powder actually required to break the face, will give the efficiency of the explosives as used, and will afford, also, a direct means of determining the advantages derived from the use of tamping. The sole object of a drill round is to allow the placing of the powder in such a manner that it will do the required work in the most efficient way, considering always the time and cost of drilling such a round of holes, and the time and cost of removing the resultant muck pile. Only by experimenting with actual rounds and with different powder allowances can it be determined how best to space the holes and how deep to drill them so as to approach maximum efficiency in the use of explosives, but if all the data are charted according to the rock classification, very definite ideas are soon developed, which will prove

of value in designing advantageous rounds for any class of work and for all sizes of headings.

A classification of ground to secure data on grinding would be made on the "grinding resistance" figure as shown in Fig. 3, but since this figure is in each case correlated with a corresponding "drill-test" figure, the millman is able to predict future changes in his practice, by securing information on the drill-speed classification of the deeper development headings in the mine.

For a comparison of data on the wear and tear of equipment in mine or the mill, the hardness of a rock (drilling speed or grinding resistance) is required, which figure will serve as a measure of the abrasive quality of the rock or of its resistance to impact.

For a measure of safe untimbered areas to be left open, as in unsupported back areas in stopes, the safe size of raw development headings and tunnels, and the degree of arching necessary to support a safe back in each case, the hardness, toughness, and occurrence of slips should be accurately known. Another point is to be considered in this connection, however; any open area which might be classed as safe according to this scheme would fail in a short time if the rock type was such that it would readily decompose or slake under the action of air and moisture. Limestones, shales, and igneous rocks with high lime-content minerals already partly altered would be examples of this, and the occurrence of slips will indicate the speed with which these rocks will develop weaknesses.

Classification for Stoping Methods

A classification of suitable stoping methods for the various characteristic rock types will also depend on three factors—hardness, toughness, and friability. Points to be determined herein are: safe areas to be left open, size of areas needing timber support, the readiness with which rock will crush under its own weight, the blockiness of the ground when so crushed, and relative data. Other considerations enter into the decision to adopt a given stoping method, but the value of a prior and proper selection of a method based on the rock characteristics is not altered by this fact. For example, a rock might be classed as ideal for caving work, being hard enough to stand untimbered in small raises and undercutting drifts, but of such a nature that when undercut it will crush by its own weight, will not be too blocky for good drawing practice, and will not pack too much, and yet, the size and shape of the orebody, grade of ore, surface or mine maintenance requirements, and character of surrounding wall rock

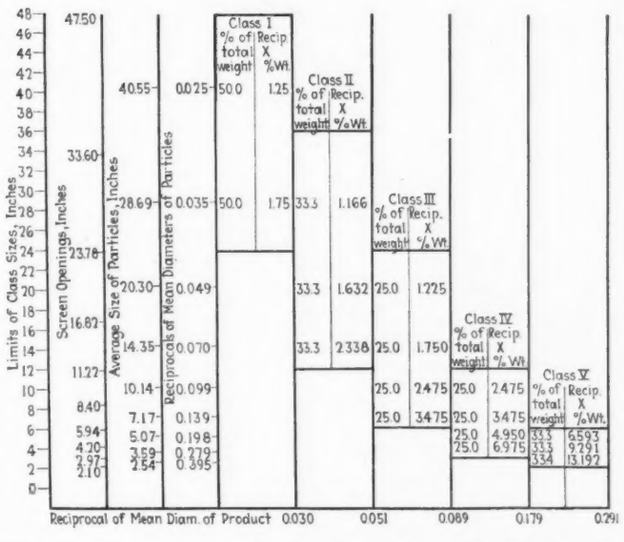


Fig. 9—Occurrence of slips in rocks: Table showing the reciprocal of the mean diameters of the rock particles making up each class of face in Figs. 4 to 8

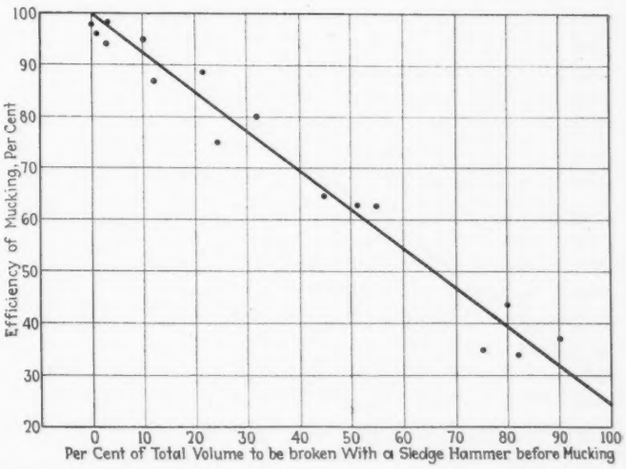


Fig. 10—Chart showing the efficiency of mucking when oversize boulders are broken with a hammer

Table Showing Reciprocal of Mean Diameter of Pieces in Ideal Muck Pile

Mesh	Size Opening, Inches	Average Size Particle, Inches	Reciprocal of Mean Diameters	Per Cent of Each Size Weight	Product: Reciprocal of Diameter X Per Cent Weight
	47.50	.....	.....	....	.....
	33.60	40.55	.025	....	.....
	23.78	28.69	.035	....	.....
	16.82	20.30	.049	....	.....
	11.88	14.35	.070	....	.....
	8.40	10.14	.099	....	.....
	5.94	7.17	.139	1.0	.1390
	4.20	5.07	.198	1.5	.2970
	2.97	3.585	.279	2.5	.6975
	2.10	2.535	.395	10.0	3.9500
	1.485	1.793	.558	8.0	4.4640
	1.050	1.268	.789	10.0	7.8900
	.742	.896	1.114	9.5	10.5830
	.525	.634	1.577	12.0	18.9240
	.371	.448	2.323	10.0	23.2300
3	.263	.3170	3.155	4.2	13.2510
4	.185	.2240	4.464	3.8	16.9632
6	.131	.1580	6.329	4.6	29.1134
8	.093	.1120	8.929	4.4	39.2876
10	.065	.0790	12.658	3.5	44.3030
14	.046	.0560	17.857	2.0	35.7140
20	.0328	.0394	25.380	3.0	76.1400
28	.0232	.0280	35.714	1.5	53.5710
35	.0164	.0198	50.505	2.0	101.0100
48	.0116	.0140	71.429	1.8	128.5722
65	.0082	.0099	101.010	2.0	202.0200
100	.0058	.0070	142.875	1.0	142.8750
150	.0041	.0050	200.000	.5	100.0000
200	.0029	.0035	285.714	.2	57.1428
...	.....	.0022	454.545	1.0	454.5450
Totals				100.0	1546.6827
Reciprocal of mean diameter					156.4683

and its effect on dilution—one or all might prohibit the use of the method indicated. As a further example, suppose ten companies submitted data on shrinkage stoping in wide orebodies, each company classing its ground as "medium hard and fairly blocky," but each giving a different width of stope and pillar and a different cost per ton. It would be fairly obvious that, other things being equal, either the ground classification in these mines was incorrect, or some of the operators were too conservative regarding the width of stopes and thickness of pillars, or some of them were possibly taking too great a risk for good practice. Now, if each of these rocks were tested according to a uniform scheme, it might show at once that although, to a casual observer, each of the ten was "medium hard and fairly blocky," yet, under test, differences might be apparent in each, which would fully explain the different practices and costs. On the other hand, it might well be that some of them could benefit greatly by adopting in full or in part the practice as used by another company working in identical ground.

Basis for Cost Determination

A complete and universally applicable method for classifying ground, by means of which the operations of mining and milling can be directly compared, or accurate prediction made as to the cost, efficiency, and general practicability of proposed operations, no matter what class of ground is involved or where the work may be located, will be of inestimable value to the mining profession. Such a scheme of classification is almost mandatory if the work of standardization now in progress at some of the larger mines is to progress to a final and satisfactory conclusion, and if the results are to become generally available throughout the industry on an accurately comparative basis without each individual company having to undertake the arduous task of determining these data for its own use. It is the real base upon which to study all of the operations of mining, and the means by which definite and practical limits may be set upon the range of applicability of each operation or method, and upon the range of practice for each class of rock, whether it be a standard drill round, a correct powder allowance, the maximum safe open area allowable, or the most efficient stoping method. Beyond these limits, as finally determined, it will be generally unwise to transcend on a large scale without first carefully considering the cost of ultimate failure of plans, unless the work is done patiently as an experiment.

The practice of classifying ground as hard, medium, soft, and so on is general in the industry when for purposes of comparison a common base is desired. And better to serve this purpose, several more thorough schemes have been advocated and used; none of which, however, has been entirely free from error, nor have any of them been complete; or they are in such form and terminology as to be suited only for local application by those few who know thoroughly the ground in which the original classifying was done. The scheme advocated and described in this paper, which is, in reality, only a combination and an enlargement of the best points of some of these prior methods, has been thoroughly tried out, and found to be adequate over fully one-half of the full range of possible ground characteristics. It offers a system that can be applied in any mine, by anybody, and the actual test work underground may be made with the drill equipment at hand. It offers a common base upon which to to build up tables of standard practice and operating data in each class of rock; and when comparisons of methods and costs are to be made of the work in several different districts it is the medium by means of which this can be fairly and accurately done, giving full recognition to the major and minor differences in the rocks in which the various methods are being used at each mine.

Broad Field To Be Covered and Co-operation Needed

The classification has been proven, so far, only over a part of the combinations of rock characteristics. There still remains the task of its simplification to a workable basis. No single investigator, confining his efforts to one mine or one district, will be able to complete the classification and compile all the data desired, for two reasons: first, because no one locality offers the full range of possible rock characteristics in which to do the test work; and, second, no one district uses even a major part of the methods and practices that it would be desirable to review in the light of a complete classification in order to select the most suitable for each condition. On the other hand, for several companies to work independently on the problem will mean a duplication of the men necessary to do a large part of the underground test work, and of the laboratory test grinding equipment; and this would entail an expense which few would care to undertake at present.

It would seem logical to organize a central laboratory supported by eight or ten of the larger companies, for a period of two years, at a very small annual expense to each. The function of the laboratory personnel would be to visit each camp and to test thoroughly the different grounds in each, to take samples for grinding resistance tests to be made at the laboratory, to gather such data on methods and practices as each company would care to submit for comparison, and to enlist the aid of the drill and powder manufacturers, they to supply data on the ratings of their drills and on the explosives used in the various mines. Well within the period of two years, if this plan were put into operation, a very valuable and useful body of knowledge could be gathered and made known to all.

Salt Production Increased in 1925

The salt produced for sale or use by operators of salt mines, wells, and ponds in the United States in 1925 amounted to 7,397,498 short tons, valued at $26,162,361, according to reports furnished by the producers to the Bureau of Mines. These figures show an increase of 9 per cent in quantity and 2 per cent in value over the figures for 1924, which were 6,803,115 short tons valued at $25,747,048. The states showing the largest output in 1925 were as follows: Michigan, 2,172,600 tons, valued at $7,710,331; New York, 2,053,966 tons, valued at $7,133,244; Ohio, 1,173,588 tons, valued at $4,116,625; Kansas, 812,539 tons, valued at $2,494,423; and Lauisiana, 500,354 tons, valued at $2,218,265.

The sales of rock salt, including pressed blocks made from rock salt, amounted to 2,342,633 short tons, valued at $7,444,799, an increase of 13 per cent in quantity but a decrease of about 1 per cent in value. New York, Kansas, Louisiana, and Michigan produced over 99 per cent of the rock salt reported in 1925.

Discussion

Solubility of Tin Minerals

THE EDITOR:

Sir—Attention is again called to the possibility of secondary enrichment in tin veins by Mr. F. R. Koeberlin.[1] The later article by Messrs. Gruner and Lin[2] seemingly refutes Mr. Koeberlin's contention that cassiterite is sufficiently soluble under certain conditions to give workable bodies of secondary cassiterite. Though Mr. Koeberlin does not say in so many words that in his opinion cupric salts are responsible for the solubility of the cassiterite, one immediately concludes that such is his belief.

Messrs. Gruner and Lin, in my opinion, have not done sufficient research work to warrant their statement that cassiterite is insoluble, particularly since they have not worked with Bolivian tin ores. Nor is it advisable, after having used only a few solutions for a period of two months, to make broad generalizations regarding secondary enrichment.

It is true that pure crystals of cassiterite are very insoluble in acids. However, the purest crystals obtainable in the Llallagua mine contain only 94 to 95 per cent cassiterite. The other constituent is iron in the form of oxide. An analysis gave the following result: tin dioxide, 94.06 per cent; iron, 4.30 per cent; sulphur, trace.

As it is generally recognized that a difference of potential is set up when two minerals are in contact in acid solution, may we not assume that this is one of the controlling factors in the solution of cassiterite? The iron oxide is finely disseminated throughout the cassiterite and there is plenty of acid in the mine waters. These factors give the necessary conditions.

SOLUBILITY OF THE TIN MINERALS OF BOLIVIA

The principal primary Bolivian tin minerals are, in order of their importance, cassiterite (SnO_2), stannite ($CuS\ FeS\ SnS_2$), teallite ($PbSnS_2$), franckeite ($Pb_5FeSn_3Sb_2S_{14}$), and cylindrite ($Pb_3FeSn_4Sb_2S_{14}$).

There is one secondary tin mineral in the oxidized zone in the Llallagua. I will not give an analysis of this mineral at the present time. Table I gives the total tin and the acid soluble tin in these minerals.

Table I

Mineral	Per Cent, Tin	Per Cent, Acid-Soluble Tin	Per Cent of Total Tin Acid Soluble
Cassiterite	75.96	0.22	0.20
Stannite	34.19	8.92	26.08
Teallite	29.42	21.83	74.29
Franckeite	13.91	13.91	100.00
Cylindrite	11.89	11.89	100.00
New Material	31.23	18.90	60.51

For these tests the minerals were finely powdered and placed in flasks of hot dilute hydrochloric acid (33 per cent HCl). After standing for one hour the solutions were filtered, reduced with nickel, and titrated with a solution of iodine. This gives the acid-soluble tin. For the total tin the sample was fused with sodium peroxide.

F. W. Clarke[3] states that the solubility of cassiterite is indicated by several natural occurrences. Cassiterite has been noted in opaline deposits, from hot springs, as pseudomorphs after feldspar, cappings on quartz crystals, and in stalactitic forms. The last two occurrences are well illustrated in the mine at Llallagua, Bolivia. I have several specimens of stalactitic cassiterite and many quartz crystals partly replaced by cassiterite, and was fortunate enough to find, in a vug partly filled with iron oxide and corroded quartz crystals, a few loose crystals of bismuthinite completely coated with crystalline cassiterite.

These occurrences are certainly indicative of deposition from solution, and the cassiterite is undoubtedly secondary. They do not tell us, however, whether the original tin mineral was primary cassiterite or a sulpho-salt. Exponents of the theory of the insolubility of the dioxide will immediately assume that this mineral was a sulpho-salt. This, of course, cannot be disproved. With the exception of stannite, the sulpho-salts of tin are very rare in this mine, but it must be admitted that there are sufficient quantities of this mineral to account for these occurrences.

The suggestion of Messrs. Gruner and Lin that the eroded parts of the veins may have carried more of the sulpho-salts than the parts now remaining cannot be accepted. Chemical analyses show that more soluble tin in the form of sulphide occurs in the lower levels than in those higher up.

Three samples of mine water[4] from the oxidized zone were analyzed for tin. The results were: Sample A, 19.4 mg. per liter; B, 145.8 mg. per liter; C, 180.9 mg. per liter. Although there are no sulpho-salts in this zone, one is not justified in claiming that the tin in these waters was derived from cassiterite because of the soluble secondary tin mineral found here. Nor can it be claimed that primary cassiterite was the source of the tin found in the deposits of geyserite formed by the still issuing hot springs near the base of the Llallagua mountain, although the tin evidently travels in the form of stannic acid.

The secondary tin mineral found in the oxidized zone was probably derived from cassiterite or stannite. Though copper may easily be removed by percolating waters, it is not improbable that traces would remain behind. In the specimens analyzed no copper could be found; hence this mineral, when present, is possible proof of the solubility of primary cassiterite.

Another form of what is evidently secondary cassiterite is the needle or honey tin. The names are derived from its shape and color. The occurrence is indicative of its secondary nature; it generally occurs on wurzite. Since wurzite is considered secondary, this form of cassiterite must be secondary. Here, again, one is unable to prove that the original mineral was

[1] *Engineering and Mining Journal-Press.* Vol. 121, Page 636.
[2] *Op. Cit.*, p. 924.
[3] Data of Geochemistry. U. S. Geological Survey Bulletin.
[4] These samples contained no copper.

Table II

No.	Solvent Used	Weight of Crystals, Grams						
		Feb.	March	April	May	June	July	Loss
1	200 c.c. H_2O 10 c.c. HCl*	4.9792	4.9772	4.9772	4.9768	4.9766	4.9754	0.0038
2	200 c.c. H_2O 10 c.c. H_2SO_4†	6.7164	6.7156	6.7150	6.7148	6.7146	6.7128	0.0036
3	200 c.c. H_2O 10 c.c. H_3PO_4‡	5.8856	5.8840	5.8834	5.8830	5.8826	5.8802	0.0054
4	200 c.c. H_2O 10 gm. NaOH	6.6014	6.6012	6.6009	6.5990	6.5980	6.5966	0.0048
5	200 c.c. H_2O 10 gm. NaOH, 10 gm. Na_2S	6.5640	6.5640	6.5640	6.5536	6.5531	6.5522	0.0118
6	200 c.c. H_2O 10 c.c. H_2SO_4, 10 gm. $Fe_2(SO_4)_3$	3.6114	3.6114	3.6118	3.6115	3.6115	3.6110	0.0004
7	200 c.c. H_2O 5 gm. HF	8.0696	8.0680	8.0692	8.0688	8.0686	8.0680	0.0016
8	200 c.c. H_2O 10 gm. NaOH, 1200 mg. tin	6.2472	6.2464	6.2470	6.2466	6.2466	6.2456	0.0016
9	200 c.c. H_2O 10 c.c. HCl, 1200 mg. tin	6.6348	6.6344	6.6342	6.6338	6.6328	6.6314	0.0034
10	200 c.c. H_2O 10 c.c. H_2SO_4, 1200 mg. tin	3.1526	3.1518	3.1524	3.1520	3.1520	3.1516	0.0010
11	200 c.c. H_2O 10 c.c. H_2SO_4 4 gm. $CuSO_4$, 1200 mg. tin	3.6070	3.6072	3.6070	3.6066	3.6068	3.6064	0.0006
12	200 c.c. H_2O 10 c.c. H_2SO_4, 10 gm. $Fe_2(SO_4)_3$ 1200 mg. tin	5.7602	5.7606	5.7606	5.7600	5.7598	5.7580	0.0022

*Sp. Gr. 1.190. †Sp. Gr. 1.840. ‡Sp. Gr. 1.154.

primary cassiterite. As it is usually found associated with the sulpho-salts, especially teallite and franckeite, it is probably derived from these minerals.

These examples of secondary cassiterite do not prove conclusively that the source was primary cassiterite, but they are at least suggestive of this. To my knowledge no wood tin has been found in this mine. Even if wood tin occurred here it would be no criterion that the parent mineral was primary cassiterite.

A specimen of wood tin was analyzed for acid-soluble tin. None was found, but an appreciable amount of tin dissolved in a solution of 3 per cent sulphuric acid and 3 per cent ferric sulphate after being heated for forty-eight hours. This finding does not agree with some other assays of wood tin from Bolivia[5]; and the disagreement serves to remind one that because a certain mineral from one place has certain characteristics it by no means follows that specimens of this mineral from other places will give exactly the same reactions.

Experimental work on the solubility of cassiterite which forms the basis of this discussion was started eight months ago. Many of the experiments will be continued for one year more. However, the results already secured serve to corroborate Mr. Koeberlin's contention that some primary cassiterite is sufficiently soluble to form enriched bodies of ore.

Experimental Data on the Solubility of Cassiterite

Crystals of cassiterite were placed in stoppered flasks with different solvents at room temperature. The crystals were removed at the end of each month, washed in three different beakers of distilled water, carefully dried and weighed. Table II gives the solvents used, the amount of each, and the weights at the end of each month.

Other series of experiments have been made and more will be made in the future. Heated solutions containing ferric sulphate and sulphuric acid, cupric sulphate and sulphuric acid, and solutions with sulphuric acid alone show that there is very little difference in the solvent action of solutions containing only sulphuric acid and those containing cupric salts. The solutions containing ferric salts dissolved approximately twice the quantity of tin as the other solutions.

In the test given in Table II the solutions were also tested for tin, qualitatively with the method used by Messrs. Gruner and Lin and quantitatively with the iodine method used in our laboratory. Sample No. 6 gives a loss of weight of 0.4 mg., and an assay of the solution showed 0.42 mg. of tin.

It will be noted that phosphoric acid dissolved more cassiterite than any of the other solvents that would be found in the oxidized part of the vein. Sodium hydroxide and sodium sulphide dissolved the largest amount, but this is of more interest from an academic standpoint than one of practical use.

To throw light upon the reactions that take place in the mine that would cause secondary enrichment, we can only consider the data for those acids and salts that are found in this mine. First, of course, is sulphuric acid and ferric sulphate; second, cupric salts; and third, phosphoric acid. Since there are no fluorides in this mine, the effects of hydrofluoric acid cannot be considered. Phosphates are abundant. Vivianite is found associated with the primary vein minerals. Wavellite is very common and is a later mineral. The rarer phosphates, vauxite and paravauxite, are also late minerals.

The solubility of cassiterite indicated by these data make it seem probable that secondary enrichment has taken place in this mine. Solutions containing tin are interesting in that no tin dioxide is deposited upon the crystals of cassiterite.

Acids of Tin

Tin in the quadrivalent form has two series of salts. One series is derived from hexahydroxystannic acid and the other derived from metastannic acid. These two acids show entirely different properties. The former is soluble in dilute mineral acids. The latter is insoluble in these acids. Hexahydroxystannic acid will change to metastannic acid under proper conditions, such as high temperatures, or it will probably change by partial dehydration to this form.

As tin veins are formed at high temperatures, the tin must be in solution as metastannic acid. However, it can easily be shown in the laboratory that a solution containing tin, whether it is an acid or an alkaline solution, if carefully neutralized will give a precipitate of stannic acid. This precipitate is soluble in dilute mineral acids. It is also soluble in alkalies and is evidently the hexahydroxystannic acid. This, then, is the acid precipitated by hydrolysis.

We may then give the events leading to secondary enrichment in this mine as follows: oxidation of pyrite forming sulphuric acid, formation of ferric sulphate, action of the sulphuric acid on the phosphates giving phosphoric acid, combined action of the acids and ferric salts on the cassiterite, probable difference of potential

[5]Bulletin Institution of Mining and Metallurgy, London, February, 1914.

set up in impure cassiterite in acid solution aiding dissolution of the primary cassiterite, neutralization of the acids at a lower level, hydrolysis of the tin salts and precipitation of stannic acid. This, on hydration, would give the dioxide of tin, cassiterite.

Llallagua, Bolivia. GERALD U. GREENE.

The Andean Salares

THE EDITOR:

Sir—In an article under the above caption that appeared in the *Engineering and Mining Journal* of May 15 the *salares* are incorrectly described as being situated on the sides of the continental divide. The *salar* region of the Andes, comprised in the Bolivian *altiplanicie* and the *puna* of Atacama, lies entirely within a zone of sunken plateaus and valleys, which was developed by the collapse of a segment of the Andean fault that disrupted the continental watershed between the 14th and 27th parallels of south latitude, and which affords one of the most conspicuous examples of interior drainage in the world.

The structure of the region is characterized by gentle folding that is often monoclinal and by profound and complex faulting, whereby a former area of comparatively inconspicuous relief was broken into a series of troughs, tilted blocks, and sunken basins. Long, narrow valleys were developed by the dropping of single blocks between parallel faults, but valleys of synclinal structure are uncommon.

A more orthodox concept of the geologic past of the province than that which is presented holds that the last general submergence took place in Upper Cretaceous time, marine fossiliferous rocks of that age being found on the Bolivian plateau and in some of the surrounding mountains. Folding and moderate uplift continued throughout the Tertiary, but were insufficient to raise any part above snow-line or to impede the passage of moisture-laden winds. At the close of the Tertiary the region underwent subsidence with concurrent rifting and block-faulting that developed both graben and broad depressed-areas. Subsequent uplift brought on the present semi-arid climate of the *altiplanicie* and *puna*. Vulcanism of varying intensity featured the long orogenic period and still endures in the modified form of solfataric and hot-spring activity, but there is no evidence that it ever attained the sudden and overwhelming violence that is popularly attributed to that ancient chimera—cataclysmic convulsion. Incidentally, the author obviously confuses volcanic action with seismic disturbance.

The *salares* differ widely in extent and thickness but fall into two general classes: Crusts of the ordinary playa type cover immense areas; massive beds of salt are much more restricted in compass and seem to be confined to basins that were formerly occupied by lakes of considerable size and depth. Halite and ulexite alternate in predominance, and general composition of the deposits differs from basin to basin in accordance with the stage and nature of the adjacent volcanic vents and hot springs.

It is plainly evident that present concentration and deposition are caused by the evaporation of groundwater and the desiccation of recurrent, ephemeral lakes, both ground-water and lakes being fed by drainage from craters, solfataras, and hot springs that, in its course to the sinks, percolates enormous beds of volcanic material in all stages of decomposition. Nevertheless, considering the geologic history of the region, it is not to be lightly assumed that the salts have been drawn from volcanic sources exclusively. A vast amount of saline matter must have accumulated in the shrinking basins of the Cretaceous sea during the period of emergence. The uplifted Cretaceous rocks of the highlands include marine sedimentary strata that are gypsiferous, and it is conceivable that contemporaneous beds of salt, likewise uplifted and exposed, long ago contributed their mass to the material of the *salares*; furthermore, unexposed beds of the same origin may be tributary to the hot springs of the present time. Such circumstances alone afford ready explanation of the fact that the aggregate of sodium chloride in the region is much greater than that of all other salts combined.

However, even were the problem of the origin of the salts resistant to the application of every other hypothesis, no argument would be necessary to demonstrate the fallacy of the author's paradoxical contention that they were derived from liquid muds and aqueous solutions that were directly expelled from volcanic craters, wherein temperatures that ranged from 1,200 to 2,000 deg. C. suffered the existence of matter in the gaseous or molten state only. The predicated mud flows, if existent in fact, issued from no craters but were caused by the saturation to fluid point, by rain and snow-water, of the beds of unconsolidated tuff that commonly mantle volcanic cones subsequent to explosive eruption. One part of their saline content was introduced by these same waters, which came ready charged therewith from fumaroles above; the other was provided by the decomposition of the feldspathic element of the tuff itself.

The form and structure of the volcanoes of the *Cordillera Occidental* denote upbuilding by a long succession of moderately violent explosive eruptions; and, although occasional truncated cones give a first impression of disruptive explosion, it is notable that dissection is generally confined to, or has progressed to a lower level on, the southern or shady side. This clearly indicates that ice and snow are the destructive agents. *Los Colorados* offers a typical example: This volcano originally presented a perfect cone that towered above the neighboring peaks, but the greater intensity of ice erosion in the higher region reduced it to about the common level of the group; and its present yawning caldera is not a crater, in the strict sense of the term, but is an erosional cross-section of the entire mountain, of which only a small, central portion is occupied by the true vent.

A rational explanation of the presence and position of gypsum and anhydrite in and about the *salares* is found in the simple chemical law whereby a saturated solution of two or more salts first precipitates that which is the least soluble. Fracture and upheaval of the *salar* crust are brought about by the alternate solution and crystallization of the salt, assisted by the expansive force of natural growth; and the expansion and contraction resultant upon diurnal temperature-range are but insignificant contributory agents in the process.

In the circumstance that the areas, the depths, and even the numerical frequency of the *salares* are unknown quantities, an estimate of one thousand billion tons of salts in sight partakes of that meticulous but imponderable exactitude which is the distinguishing feature of a late official calculation of our national petroleum "reserves," wherein the inspired imagination of the computing fabulist constitutes the sole limiting factor. ROBERT HAWXHURST, JR.

San Francisco.

Consultation

Fouling of Cyanide Solutions

"Local regulations forbid the presence of cyanide solution in the streams near our mill. It may prove desirable to run a certain amount of cyanide to waste. What is a cheap and simple method of destroying the cyanide before discarding the solution?

"When solution is repeatedly circulated through a plant, with little or no wastage, and fouling is suspected, can this be confirmed by a simple test, without recourse to chemical analysis? Further, under these circumstances, what method would you recommend to insure that the working solution should always be kept in fresh and active condition? I noticed that difficulties arose at the Rosario mill through fouling of the solution in circuit, and recourse was had to a complete change of the brand of cyanide in use."

The following letter from Paul T. Bruhl, Rosario, Honduras, is in answer to the questions asked by our correspondent:

"With respect to the enquiry made by a correspondent as to a suitable method of destroying the cyanide in a solution that is to be run into a stream, I have to say that in West Africa, where similar regulations as to the pollution of public streams obtained, ferrous sulphate was employed as a cyanicide. I imagine that potassium permanganate would be equally efficacious.

"With regard to the fouling of solutions to such an extent that it becomes imperative to discard part of the circulating solution, my opinion is that such serious fouling must be uncommon, as I personally have not come across a single instance of it. Your correspondent mentions the Rosario mill, where we found it necessary for the best all-round results to use a mixture of white and black cyanides. Although there was no doubt that the solution was becoming somewhat foul, after prolonged use of black cyanide in large quantities there was at no time any necessity to discard part of it. Even with the best type of filter there is usually enough solution discharged with the cake to keep the circulating solution in good condition.

"Your correspondent could perhaps keep a useful check on his solution by taking the specific gravity of it every week. If fouling actually does occur and the size of the mill or other considerations do not warrant the installation of a cyanide-recovery process plant there seems to be nothing to do but discard part of the solution. The necessity for this replacement will be evidenced by the drop in extraction. An "Extraction-Specific Gravity" curve can be drawn and the necessary replacement can be made when the economic point on the curve is reached.

Narrow Market for Jet

"Would you be kind enough to inform me what use is made of jet and what price can be obtained for it?"

Jet is used in the jewelry trade, though not extensively. Its use is principally for mourning jewelry, and there are only a few manufacturers who supply the entire demand of the industry. As far as we know, these manufacturers confine themselves to the Whitby jet, of England, which has been the jet used in the jewelry trade for about a century. They do not seem to demand any other jet. What appeared to be very fine jet sent from Utah and other sections of the country has been refused in the trade, most of the manufacturers to whom it was submitted saying it was valueless to them as they use only the Whitby product. You might consult some of the jewelry manufacturers or dealers in semi-precious stones on the chance that there may be some market for your product.

Mineral Specimens

We are glad to publish the following letter from Ward's Natural Science Establishment, P. O. Box No. 46, Beechwood Station, Rochester, N. Y.:

"On page 894 in your 'Consultation' department of the issue of May 29 we note an inquiry for mineral specimens, and your reply makes no mention of our Establishment. This seems to us exceedingly strange, as we are known all over the world as the largest and most reliable dealers in mineral specimens and collections. We have been in the business for sixty-four years at the same place. The Establishment is not operated for profit, but is purely an educational philanthropy seeking to render as great service as possible to science. Not one dollar of profit has been paid to our stockholders during the thirty-six years of our incorporation, and our aim is to furnish scientific materials at prices as low as they can possibly be supplied, any gross profit which we make being simply for the purpose of covering our expenses of securing and marketing the material. We believe that it would be worth your while to refer such inquirers to us in the future."

Patented Apparatus for Charging Zinc Retorts

"I am much interested to know whether or not a patent has ever been taken out on a machine for charging zinc-furnace retorts consisting of a high-speed belt delivering the charge into the retorts by centrifugal force, and will highly appreciate any assistance you can give me. If a patent was issued on a charging device of this nature it was five or more years ago. If you can find any such record I should like to have the data and the number of the patent and information as to whom it was issued.

Patent No. 716,201, of Dec. 16, 1902, issued to De Brower, covers an apparatus for recharging retorts. This was not primarily intended for charging zinc retorts, but was used for the purpose, and we believe that both the Isbell-Porter and Bartlett-Hayward companies have built these machines. Whether they are working under this patent or not we are not sure, but it is one that is closely allied with it, if not the same.

Mill Sites and Mineral Rights

"Will you please answer the following question: Does a mill site carry with it the right to mine on the same ground?"

The United States statute on mill sites states that "where non-mineral land not contiguous to the vein or lode is used or occupied by the proprietor of such vein or lode for mining or milling purposes, such non-adjacent surface ground (not exceeding five acres) may be embraced or included in an application for a patent to such vein or lode, and the same may be patented therewith, subject to the same preliminary requirements as to sundry and notice as are applicable to veins or lodes."

It would appear to us that if after acquiring a mill site mineral were discovered on it, the ground would have to be located as a mineral claim in the usual way. The purpose of the provision for locating a mill site is to permit the acquisition of surface rights without discovery of mineral.